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"*To the solid ground
Of Nature trusts the mind which builds for aye.*"—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
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THURSDAY, MARCH 1, 1917.

CLASSICAL EDUCATION.

A Defence of Classical Education. By R. W. Livingstone. Pp. xi+278. (London: Macmillan and Co., Ltd., 1916.) Price 4*s*. 6*d*. net.

THIS book is, unfortunately, based upon two misconceptions, both of which are common amongst classicists. In the first place, it is assumed that an attempt is being made at the present time to abolish classics from general education and to replace them by scientific studies. This is far from the truth. Men of science claim no privileges for their own subject which they are not prepared to grant equally to classics and to the other branches of learning. Narrow specialisation in any one department, whether classical or scientific, we hold to be thoroughly bad from an educational point of view.

The author has little knowledge of the aims of those who wish to reform modern education. From the frequent references to the conference held last May on the neglect of science he has evidently taken the report of these proceedings as his basis. He then proceeds to isolate statements and phrases from their contexts, and from such he builds up an entirely erroneous and hypothetical attack which he attempts to demolish to his own satisfaction.

What is the system of classical education in force at the present time? At an early age a boy goes to a preparatory school where education has classics as its dominating note from the outset; in many cases twelve hours a week are devoted to Latin alone. Since the great majority of entrance scholarships to public schools are virtually awarded on a knowledge of classics, the able boys are then further hot-housed in this subject, practically to the exclusion of all other branches. On arrival at a public school, and having attained a certain proficiency in classics, boys are unlikely to wish to change to other subjects or to be allowed to do so if they wish. Thus the most clever boys are diverted from science quite early in their lives, and consequently we get all the evils of early specialisation, which results in boys of fourteen and fifteen devoting as much as twenty-five hours a week to this one branch of learning—classics.

This is education as at present interpreted in our public schools; this is the system which is being attacked so strenuously; this is the ground which, we venture to suggest, needs an abler pen than that of Mr. Livingstone to defend successfully. As a matter of fact, the title of the book is a misnomer, for the work is not a defence of classical education at all. Not a single argument is adduced to support the conclusion that "the first stage of classical education may be left alone. It is as satisfactory as most things in education are likely to be."

As a plea for the retention of classics in a general scheme of education, the book is excellent. Where Mr. Livingstone is dealing with facts he is on safe ground, and the majority of the work is a "hymn of praise" which is wholly admirable. His assumptions, however, are nearly always erroneous, and his conclusions illogical; one cannot help thinking that a little knowledge of scientific method would have saved him from many pitfalls.

The truth is that, although he does not admit it, and although, possibly, he does not know it, he is almost as much a reformer as the present-day advocate of science. Let us quote:—"The world is far more intelligible to us if we have studied literature." "The value of history is even more obvious." "To be ignorant of the world in which we live, to have no idea of how plants and animals grow, to know nothing of electricity and chemistry, is to deny ourselves whole provinces of knowledge." "Physical science corrects the vices of a literary training, its tendency to make men retrospective, critical, inactive spectators of the world." "Obviously any good education will include the teaching of science." "It ought to be a first aim to avoid diverting boys with mechanical and scientific

tastes, who have no aptitude for linguistics, into studies that will be barren for them."

Such phrases as these constitute a plea for devotion of more time to literature, to history, and especially to science. If the author's ideal is to be realised, it can only be done by an alteration of the curriculum, to some extent at the expense of classical studies. If "the first stage of classical education should be left alone," how does he propose to secure the wider type of education which both he and ourselves advocate?

It is on record that the head of an Oxford college urged that, since it was desirable that clergymen should know Greek, and since it was very often late in life before a man ultimately made up his mind whether he was going to be a clergyman or not, therefore all boys and young men were to be regarded as potential clergymen until that critical age was passed. We strongly suspect the author of similar views, with the exception that he would keep only the able boys at classics and hand over the dullards to science.

The second misconception is that science means merely the acquisition of facts. Science can give far more than the classicists imagine. The division of branches of knowledge into "humanistic" and "scientific" is an error of nomenclature; for science may be made the most humane of all studies. In the words of a recent manifesto: "Imaginative power indicates new fields in which further knowledge of truth may be revealed; its full establishment depends upon accurate observation, with constant recourse to Nature for confirmation. The one aim of natural science is, in fact, the search for truth based on evidence rather than on authority. The special value of natural science in the training of mind and character lies in the fact that the history of the subject is a plain record of the search for truth for its own sake."

SCIENTIFIC ENGINEERING.

(1) *Leçons sur le Fonctionnement des Groupes Electrogènes en Régime Troublé.* By Prof. L. Barbillion. Pp. ii+306. (Paris: Gauthier-Villars et Cie, 1915.) Price 11 francs.

(2) *Electric Switch and Controlling Gear.* By Dr. C. C. Garrard. Pp. xviii+656. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 15*s.* net.

(1) THE smooth working of steam or hydraulic prime-movers directly coupled to dynamos is one of great importance to supply station engineers. In this work Prof. Barbillion, the director of the Technical Institute at Grenoble, gives us a thorough and well-reasoned discussion of the subject. Much of the discussion, we are afraid, is too mathematical to be properly understood by the ordinary English engineer, but to the specialist and the advanced student it will be interesting and instructive.

In the first chapter curves are given showing how the torques produced by steam-engines and hydraulic turbines vary with the velocity for a given admission of steam or water respectively. Expressions are then found for the "useful" torque produced by the prime-mover, and differential equations are obtained for the dynamical equilibrium of the combined set under various conditions of load. These equations admit of easy solution. The problems of regulation and the *rôle* of regulators are next discussed. The effects produced by flywheels, various types of Watt's governor, air and oil brakes, etc., are investigated mathematically and the solutions illustrated by curves.

Expressions are found for the magnitude of the variation of the velocity produced by a given disturbance, the case when the resisting torque varies as the angular velocity being specially considered. Various devices for damping out irregularities in speed are described, and finally in the last two chapters a valuable descriptive study is made of the mechanisms required to keep the engine running at constant speed, and also of the devices required to make the speed of the engine increase with the load. The book is founded on a course of lectures given by the author to technical students. It illustrates well the great practical value of mathematics to engineers.

(2) As a work of reference this book is of value. Much of the information in it is novel, and the problems discussed are those which are exercising the minds of electrical engineers at the present time. Many of the practical devices in everyday use have their limitations, and some are of very doubtful utility. Dr. Garrard's critical remarks, therefore, will be most helpful in clearing up the mystery attending their operation.

In the first chapter materials and manufacturing methods are described. It shows clearly how scientific ordinary commercial engineering is becoming. In the old days the purchaser of raw materials made a cursory inspection of all the samples, and if they appeared to be of the same quality he accepted the lowest price. This is no longer the case. Consider, for instance, the purchase of the oil used for insulating high-tension apparatus. The buyer insists on knowing the electric strength, the flash-point, the viscosity, the specific gravity, the freedom from acid and alkali, the mineral impurities and additions, and the rate at which oxidation products are formed when ozonised air is passed through the oil. Similarly, other materials used in construction will have to conform—or will soon have to conform—to rigid and highly scientific specifications. In this connection the work done by the Engineering Standards Committee and by the many committees of the Institution of Electrical Engineers is worthy of high commendation. The co-operation between engineers, business men, mathematicians, physicists, and chemists is in every way satisfactory, and promises well for the future industrial welfare of the country.

Descriptions are given of apparatus for making and breaking electrical circuits, for obviating danger, for regulating the current and pressure, for starting and controlling running machinery,

and for protecting electrical machines and cables against abnormal electrical conditions due to faults or atmospheric disturbances. A discussion is also given of the design of switchboards. In almost every chapter many interesting and important practical researches are suggested. Some of these researches have already been begun and valuable results have been obtained. The industry is already beginning to feel the benefit of co-operative research.

On p. 553 a formula is given for the maximum electric stress between the horns of a lightning arrester. It is, however, merely the formula for the maximum electric stress between two infinitely long cylindrical wires. Apparently the assumption is made that the bending of these wires into the shape of horns does not appreciably alter the electric stress. The further assumption is made that the value of the disruptive stress in air is 25 kilovolts per cm. This is not true. For two parallel wires in air, if r be the radius of either measured in centimetres, the greatest possible value of the electric stress is $30+9/r^{\frac{1}{2}}$ kv. approximately at 25° C. and 76 cm. pressure (1·013 millibars). It is therefore not independent of the thickness of the wires. Before we can compute the breakdown voltage we need to know the formulæ for the disruptive stress with the given size of wire and for the maximum electric stress. The latter is a definite mathematical problem which has not yet been solved.

The diagrammatic symbols employed by the author are good, although in a few cases he is not consistent. In an appendix the symbols recommended by the British Electrical and Applied Manufacturers' Association (known as the Beama) are given. We have good grounds for hoping, however, that agreement on all the diagrammatic symbols used in electrical work—some 200—between all the English-speaking races will shortly be obtained.

A. RUSSELL.

AN AGRICULTURAL POLICY.

British Agriculture: The Nation's Opportunity. Being the Minority Report of the Departmental Committee on the Employment of Sailors and Soldiers on the Land. By the Hon. E. G. Strutt, Leslie Scott, and G. H. Roberts. With a preface, and appendix on the Reclamation of Land, by A. D. Hall. Pp. xi+168. (London: John Murray, 1917.) Price 3*s*. 6*d*. net.

IN July, 1915, a Departmental Committee was set up "to consider what steps could be taken to promote the settlement and employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise." Within six months Part i. of the report was published, urging a policy of closer land settlement by the creation of more small holdings and the carrying out of various minor reforms. Before Part ii. was published certain changes were made in the *personnel* of the committee, and a minority report was drawn up by Messrs. the Hon. Edward Strutt, Leslie Scott, and G. H. Roberts, who felt unable to sign the majority report. This minority report forms the subject of the present book.

A considerable portion of the book is occupied by the preliminary section on the "policy of the plough," by an anonymous author styling himself "Free Trader," who attempts to justify the establishment of a State policy towards agriculture. In the past, as he points out, cheapness was the main consideration. The only thing the country cared about was that its bread and meat should be cheap, and it was supposed to be immaterial whether the commodities were produced here or elsewhere. And for a variety of reasons, which we need not now discuss, they tended more and more to be raised elsewhere, until the outbreak of war found us producing only about half our total food, and only about one-fifth of the wheat we need. Had the submarine menace been really effective we must have been starved out. Thoughtful people of all political views are therefore asking what is being done to ensure a stronger and better developed agriculture.

The minority do not consider that the recommendations of the majority report go far enough, and not being given to half-measures, they have evolved a scheme of their own. Their aim has not been to make farming more prosperous, but to make it more effective as a means of producing food and supporting a vigorous population. Three conditions are laid down as being necessary to success. First, the level of prices must be put sufficiently high to make farming a safe and remunerative occupation for men and capital; secondly, the position of the labourer must be improved as regards wages, housing, and the amenities of life; and, lastly, the landowner must realise that he has a responsibility to the community.

All this is, of course, entirely subversive of the old *laissez-faire* policy. "It is the duty of the nation," say the authors, "to provide for its sailors and soldiers. It is to its interest that the rural population and our home output of food should be increased. We believe that the end of this war will afford an absolutely unique opportunity of achieving these great ends." An adequate wage, a good cottage, the attractions of a living community, and the chance of rising are necessary so far as the men are concerned, and must be provided by State action. No uniform wage is suggested, but the establishment is recommended of district wage-boards, having power to see that wages do not fall below such a minimum standard as will enable the industrious man to keep himself and his family in physical health and efficiency. The chance of rising is to be provided by small holdings, which, however, will require to be on a sound basis.

But this plan can only succeed if the farmer's interest is made identical with that of the State; at present it is not. The farmer might meet the demands for higher wages as his predecessors did in the early 'eighties—by dismissing his men

and laying the land down to grass. This, of course, would be disastrous. To avoid it, a guaranteed minimum price of 40*s.* to 42*s.* per quarter for wheat should be offered for the next ten years; in addition, a bonus of 2*l.* should be given for each acre of grassland ploughed up. Possibly an import duty would be needed to pay the cost of the guarantee, but the authors prefer not to discuss the details too minutely. The Board of Agriculture should take over several grass farms in different parts of the country and run them as demonstration farms, showing how best they may be broken up and converted into arable land. As minor reforms the authors suggest that some of the munition works should be turned on to produce agricultural machinery after the war, and that special attention should be devoted to the sugar-beet and potato industries, both of which are capable of considerable development.

It is gratifying that agriculture is now receiving so much attention, and one can only hope that something will emerge to give it direction and impetus. There is a growing tendency in favour of definite State action, and everything is gained by having the matter well discussed beforehand.

OUR BOOKSHELF.

Highways and Byways in Nottinghamshire. By J. B. Firth. With illustrations by Frederick L. Griggs. Pp. xviii+426. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net.

ALTHOUGH the county of Nottingham cannot perhaps claim a place among the most picturesque of the English shires, it can nevertheless show many attractive landscapes, more especially in the valley of the Trent and in the splendid remnant of the ancient forest of Sherwood. While mainly concerned with the towns and villages, the castles, abbeys, churches, and mansions of the county and the historical associations attached to them, Mr. Firth has done full justice to its physical features, and has produced what is certainly one of the best books yet written on Nottinghamshire.

Perhaps the best chapters are those on the forest and parks of Sherwood, full of "the glamour of a romantic past and the charm of living immemorial beauty. As a district of enchantment, of old oaks, of noble names, of great memories, of high romance, it has not its peer in England. The New Forest may vie with it in the beauty of its woodlands, but it has few associations to match those of Sherwood."

Sherwood Forest, moreover, is full of interest to the naturalist, as might be expected in a region of primeval woodland; many of the constituents of its fauna are, indeed, peculiar to it. Such matters, however, would be out of place in a work of this kind, and as a matter of fact there is not a word in the book on the geology or natural history of the county, unless we except the reference to the Nottingham crocuses and the forest flies of Sherwood. In describing the Nottingham meadows in spring as "ablaze with fairy gold," Mr. Firth makes a curious slip, for the Nottingham crocus is, of course, the purple-flowered species!

The book is profusely and beautifully illustrated, and the large-scale maps will be invaluable to the explorer of the byways of Nottinghamshire.

Index of Genera and Species referred to, and an Index to the Plates in "The Ibis" (seventh, eighth, and ninth series), 1895–1912. Edited by William Lutley Sclater. Pp. 513. (British Ornithologists' Union: sold by W. Wesley and Son, 1916.) Price 1*l.* 12*s.* 6*d.*

THOSE who study or refer to the more recent volumes of the *Ibis* will welcome the successful completion and issue of the third index of genera and species referred to, and an index to the plates. This covers the seventh, eighth, and ninth series, or eighteen volumes, and saves a tedious reference to a corresponding number of separate indexes. The two previous indexes, each covering fifteen years, published in 1879 and 1897 respectively, contained 431 and 471 pages. The present volume contains 513. This increase is chiefly caused by the adoption of the trinomial system of nomenclature, which necessitates three references to each bird mentioned under its generic, specific, and subspecific names respectively. The compilation of this great index was entrusted by the committee of the British Ornithologists' Union to Mr. Henry Peavot and Mr. Thomas Wells, and they are to be congratulated upon the able manner in which they have carried out their laborious task. The general supervision of the work, as well as the reading of the proof-sheets, a toilsome and tedious business, was undertaken by Mr. W. L. Sclater, the editor of the *Ibis*. The list of plates occupies eleven pages, showing that the later series of the *Ibis* have been well illustrated, though the coloured portraits of species may be relatively fewer than in the earlier volumes.

Macmillan's Geographical Exercise Books. With Questions by B. C. Wallis. I. *The British Isles.* II. *Europe.* III. *The British Empire.* IV. *The Americas.* V. *Asia and Australasia.* Pp. 48 each. (London: Macmillan and Co., Ltd., 1916.) 7*d.* each. Keys, 2*s.* 6*d.* net each.

THE plan of these books is to enable pupils to learn geography by doing something for themselves. Each left-hand page provides a clear outline map—quarto size—either suitably contoured or showing political divisions, which the pupil is to fill up by answering carefully graded questions of a sensible kind, which are printed on the right-hand page. In the keys, intended for the use of the busy teacher, the maps are correctly filled in, and the questions are annotated where necessary with hints to the teacher on points he should emphasise and amplify when discussing the questions with his pupils.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

British Optical Science.

THE following paragraph is taken from a report on national instruction in Technical Optics, published recently under the auspices of the Board of Scientific Societies :—

"A further need, which is urgent, is the supply of standard text-books dealing with those parts of Optics which at present are greatly neglected in this country; this includes practically the whole of Geometrical Optics and a large part of Technical Optics. In our opinion the quickest and most effective method of dealing with this requirement is by publishing translations of existing foreign books and abstracts of important papers on the subject."

The recommendation contained in the last part of this extract is admirable if carefully carried out, and applies to all substantial scientific literature, as well as to Geometrical Optics. But the reason assigned, though doubtless prompted only by our national habit of self-depreciation, is unwittingly a reflection on the numerous treatises on the subject, some of them of high originality, and of Continental repute to judge from the references to them, that exist in the English language. If the reason advanced had been that many of these treatises are weak on the technical side, which is important, not on account of scientific principle, but solely or mainly through its connection with workshop practice, it would have struck the mark. It is in British optical manufacture, not in British University instruction and discovery, that there has been lack of appreciation, until recent years, of what organisation, and co-operation between theory and practice, can do, and have done in other countries. It is in the trade that we had fallen behind, for the usual reason that it is easy and profitable to hold an agency for an efficient and pushing foreign organisation, but quite another matter to compete with it. The works of Heath, Herman, C. S. Hastings, Schuster, R. W. Wood, and many others dealing with Geometrical Optics (not to mention the encyclopædia articles of Lord Rayleigh and other writers) do not seem to be in any way inferior to Continental books, themselves not very numerous; as regards the substantial number of recent works on the technical side of the subject by English and American writers I am not much in a position to judge, for the reason indicated above, but I see no ground to doubt their value. Nor, within my own knowledge, is there any ignorance of the higher development of Geometrical Optics in such a technical school as the Northampton Institute at Clerkenwell.

In fact, one may be pardoned for what otherwise might seem an invidious remark, that in the vast expansion of optical science and practice during the last century this country has had more than its share. The evolution of the spectroscope, the mightiest modern weapon of astronomical and ultimate physical research, has been effected mainly in England and America: names such as Rayleigh, Rowland, and Michelson at once occur to mind. For a long period the construction of the great telescopes of the world was a British and Irish speciality; it has now gone largely to America because it is there that they are wanted. One need only glance at the references in Czapski's admirable book—itself an excerpt from a German Encyclopædia of Physics—to see that the treatment of aberrations was set on a scientific basis mainly by J. Herschel and Airy and Coddington. The early theoretical work of Roger Cotes and R. Smith was indeed largely anticipated in Holland by Huygens; but one can imagine what a gap would be made in the science if the Geometrical Optical work of Thomas Young, Sir W. Rowan Hamilton, and others named above, and more of comparable merit still happily in active production, were excluded.

On the other hand, there is the old Munich school of Fraunhofer and Steinheil, with their theorist in aberrations, von Seidel, of supreme rank, though now a thing of the past. But the great modern object-lesson is the scientific organisation and commercial success of the firm at Jena under the direction of Zeiss and Abbe, apparent mainly in the smaller optical appliances which are commercial articles. It has been due, as is well known, largely to their enterprise in making experimentally all the kinds of glass that had a chance of proving useful, and tabulating their optical qualities. But the very same problem was attacked in this country more than half a century ago by a solitary scientific worker—the Rev. W. Vernon Harcourt—and pursued for many years into practical results with the unrivalled advisory collaboration of Sir George Stokes; and it is understood to be generally admitted that, with the aid of even a very small subsidy from public sources, their neglected labours would have solved the problem that in other hands has carried so much *éclat*. Nor should the public-spirited work of British glass-makers be forgotten, in our new-born and most praiseworthy zeal; the improvements effected at Chance's works at Birmingham under the direction of John Hopkinson are classical, and the inspiring energy of Sir David Gill promised just before his death fruitful developments in the astronomical direction, both there and at Blackfriars.

JOSEPH LARMOR.

Cambridge, February 17.

The Bursting of Bubbles.

THE interesting letter appearing under the above title in the issue of NATURE for February 15 reminds me of a different, but equally simple, method of producing the same phenomenon, described in the Proceedings of the Physical Society, vol. xxviii., p. 59, 1915. There, in order to avoid obscuring the issue, the bubbles are said to discharge minute clouds of smoke; but, as often as not, smoke-rings like those described by Mr. Campbell Swinton and Miss Beale were obtained by Mr. Moss. In this method bubbles (of air) of any desired size can be used. These are filled with smoke by placing a wire, conveying a current of appropriate strength (easily determined by trial), above the end of the tube through which they enter the oil. A similar phenomenon is exhibited, very effectively, in a well-known experiment with phosphoretted hydrogen.

S. W. J. SMITH.

Imperial College of Science and Technology,
February 16.

Thermodynamics and Gravitation: A Suggestion.

THE recent experiments of Dr. P. E. Shaw (*Phil. Trans.*, ccxvi., 1916) seem to show that the "gravitation constant" has a temperature coefficient. It is remarkable, too, that G seems to be only appreciably influenced by increasing the temperature of the larger attracting mass.

The application of the principles of thermodynamics, while affording no explanation of gravitation itself, may offer an explanation of the temperature coefficient if it exists. One assumption only is required, namely,

that the approach of an attracted mass towards an attracting centre is accompanied by a rise in temperature, or, for the approach to be isothermal, heat must be taken away from the approaching mass.

Let us suppose a mass m grams is attracted with a force F dynes by an attracting mass M grams at a distance r cm. On an F,r diagram draw the Carnot cycle ABCD, AB and CD being isothermals at absolute temperatures θ and $(\theta-\delta\theta)$ respectively, BC and DA being adiabatic changes in the distance between the attracting centres. Take the mass m round the cycle. Let the heat supplied along AB be $m.\delta Q$ ergs, where δQ is the heat required to keep the temperature of 1 gm. constant when the distance changes from r to $r+\delta r$.

By the second law of thermodynamics the work done in the cycle is $m.\delta Q.\frac{\delta\theta}{\theta}$ ergs. The work is also given by the area ABCD, *i.e.* $\left(\frac{dF}{d\theta}\right)_{r\text{ const.}}\times\delta\theta\times\delta r$ ergs.

Hence $$m.\delta Q=\theta\left(\frac{dF}{d\theta}\right)_r.\delta r,$$

which means that

$$m\frac{\partial Q}{\partial r}=\theta\frac{\partial F}{\partial\theta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Let the Newtonian law hold for isothermal changes in the distance between the attracting centres, then

$$\frac{\partial F}{\partial r}=-\frac{2GMm}{r^3} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Also, if s is the specific heat of m in ergs we have for r constant

$$\frac{\partial Q}{\partial\theta}=s \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

From (3) we get

$$\frac{\partial^2 Q}{\partial r.\partial\theta}=0.$$

From (1) we get

$$\frac{\partial}{\partial\theta}\left(\frac{\theta}{m}.\frac{\partial F}{\partial\theta}\right)=\frac{\partial^2 Q}{\partial r.\partial\theta}=0,$$

$$\therefore \frac{\theta}{m}\frac{\partial F}{\partial\theta}=f(r),$$

whence $$F=m.f(r).\log\theta+\phi(r).$$

Putting this in (2) gives

$$m.f'(r).\log\theta+\phi'(r)=-\frac{2GMm}{r^3}.$$

This requires that

$$f'(r)=0, \text{ and } \phi'(r)=-\frac{2GMm}{r^3}.$$

Hence $$f(r)=A \text{ and } \phi(r)=G\frac{Mm}{r^2},$$

which give $$F=G\frac{Mm}{r^2}+A.m.\log\theta,$$

i.e. the greater the mass the temperature of which is raised, the greater the correction due to temperature.

If the force of attraction between two masses at constant distance is F_1 when one of them is at a temperature of θ_1, and F_2 when that same one is at θ_2, then, other things being constant, we have

$$F_2-F_1=A.m.\log\frac{\theta_2}{\theta_1},$$

where m is the mass the temperature of which is raised.

Calculating A from Dr. Shaw's results gives the approximate value of $1\cdot4\times10^{-12}$. Poynting and Phillips (Proc. Roy. Soc., A 76) used 208 grams attracted by the earth and the temperature was varied between $-186°$ C. and $+100°$ C. Hence the change in the attracting force would be

$$A.m.\log\frac{\theta_2}{\theta_1}=1\cdot4\times10^{-12}\times208\times\log_e\frac{373}{87}\text{ dynes}$$
$$=4\times10^{-10},$$

or a change of 1 in 5×10^{14}, which Poynting and Phillips could not possibly detect.

GEORGE W. TODD.

Newcastle-upon-Tyne.

DESTRUCTIVE WILD BIRDS.

ONE of the evidences of the awakening in the public mind to the importance of the subject of the status of wild birds in relation to agriculture, horticulture, forestry, and fisheries is the annual newspaper correspondence. The subject has been dealt with year by year in a large number of papers, from the *Times* to the local village weekly. Unfortunately the attitude assumed by the majority of the correspondents is one based largely upon want of knowledge and a misconception of the subject under discussion. Whilst one section of writers presupposes that the majority of wild birds are distinctly injurious and should be ruthlessly destroyed, the other regards all birds as beneficial and advocates stringent measures for their protection. Such extreme views are both wrong and retard rather than aid a true understanding of a most complicated, but all-important, subject.

At a time when it is almost imperative that the land should be made to produce its maximum yield, it is doubly important that any factor that acts as a deterrent should be better understood and receive more than passing attention. The vexed question of the economic status of our wild birds is indeed a matter that calls for a very thorough, exhaustive, and continued inquiry.

From the first class of writers mentioned above one would conclude that little or no trustworthy evidence is forthcoming, and that we possess no exact knowledge of the feeding habits of any wild birds, the changes in feeding habits, their relation to the destruction and distribution of weeds, etc. Such, however, is far from the truth. Whilst, unfortunately, we have no State department or organisation engaged upon an investigation of the subject, tabulating records and results year by year, and spreading the information thus obtained amongst the people most interested, for more than thirty years there has been a small but enthusiastic number of private workers whose cumulative work has provided us with a most valuable mass of facts and original observations, and, thanks to these workers, it is now possible to state definitely that at the present time there is ample evidence of a far-reaching kind to prove:—

(i.) That no quarter should be shown to the wood-pigeon, which is one of the most destructive birds with which the agriculturist is confronted, and that every means should be taken to destroy it.

(ii.) The results of an investigation carried out by the writer in 1907–8–9 upon the feeding

habits of the rook, supplemented by similar work by Thring, Florence, and Hammond, clearly go to prove that this bird is far too plentiful at the present time, that it prefers a grain diet, and that it is injurious.

(iii.) In a like manner it has been shown that the starling has increased in numbers enormously during the last twelve years, and so long as these numbers are maintained this bird must prove a source of considerable loss to the farmer.

(iv.) The bullfinch and the blackbird in fruit-growing districts are most destructive, and cause great losses to growers. Both species demand drastic measures for their reduction.

Further instances might be quoted, but the above will suffice to show that definite and indisputable evidence can be obtained with reference to the feeding habits of any particular species of wild bird.

If the results obtained in investigations of this kind are to be of any practical value, the evidence must be thorough and overwhelming. Elsewhere[1] I have set forth in detail the procedure that is necessary in order to obtain this information, and nothing short of the greatest thoroughness and accuracy can lay claim to thoughtful consideration.

The statement is frequently made that notwithstanding a little harm that certain birds occasionally do at particular seasons of the year, as a class they are beneficial. If this be so, it seems to me most important that we should know which species are the culprits, the extent of the damage or loss they occasion, and the frequency with which they occur throughout the country, in order that so beneficial a class of animals should be rid of their "black sheep," and their fair repute remain impeccable.

Unfortunately such a statement is only partly true, and in the present state of our knowledge it cannot be denied or upheld upon practical evidence. This, at least, we do know: that many species of wild birds are protected that are distinctly injurious, in consequence of which hundreds of thousands of pounds' worth of food is annually destroyed by them; that there are many species of wild birds which are annually destroyed in large numbers, and that the food of these species has been proved to consist almost entirely of farm vermin, which latter exact an enormous toll upon the produce of the land; finally, that there are a number of species with reference to which we know comparatively very little as regards the nature of their food and feeding habits, and before they can be said to be beneficial, injurious, or neutral, much more detailed information is required.

At the present time farmers and fruit-growers throughout the land are indiscriminately destroying wild birds, so that a recent writer states: "Some of the very greatest friends that our nation has are being destroyed without mercy. . . . If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

The hands of our legislators are tied, for, as I have elsewhere stated,[2] "the need of continued investigation upon a subject so intimately related to our food supply must be patent to even the most casual inquirer, for without a thoroughly reliable and extensive knowledge of the subject it is impossible to frame wise and beneficial laws relating thereto."

Hitherto the State has not thought the subject worthy of serious attention (if it has acted it has done so too late or inefficiently), but the exigencies of the present abnormal times may compel it to do so, and to rue that it has been so apathetic and neglectful of the subject in the past.

WALTER E. COLLINGE.

[1] Journ. Roy. Hort. Soc., 1917, xlii., part 1; and more briefly in NATURE, January 7, 1915.

[2] Journ. Roy. Hort. Soc., 1917, xlii., part 1.

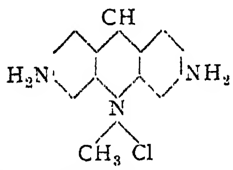
NEW ANTISEPTICS.

NOT the least important feature of the present war is the interest which has been concentrated on the effective treatment of septic wounds. Attention has already been directed (NATURE, February 10, 1916) to the use of the hypochlorite solutions of Dakin and Lorraine Smith, and to that of chloramine-T of Dakin, Cohen, Daufresne, and Kenyon. These substances, whilst they possess strong bactericidal properties, have little or no irritant or toxic action in antiseptic strength, and have in consequence found very general and successful application. The latest contribution to the subject, by Messrs. Browning, Kennaway, and Thornton, and Miss Gulbrausen, of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, is embodied in a report to the Medical Research Committee. It was published in the *British Medical Journal* of January 20; and the daily papers have lately devoted attention to the subject.

The defects of most antiseptics lie in the fact that, whilst they act chemically on proteins and so destroy bacteria, they also affect the serum, which has itself powerful antiseptic properties. This probably explains the large reduction in bactericidal action of most antiseptics in presence of serum. Furthermore, most antiseptics inhibit phagocytosis and so deprive the body of one of its most important weapons in combating local infection. An ideal antiseptic should therefore combine powerful bactericidal action along with the absence of deleterious effect on phagocytosis or on the nature of the serum. It should further be without irritant or toxic action, whilst stimulating healthy granulation.

Among the substances which the authors have examined are a number of triphenylmethane dyes (malachite green, brilliant green, crystal violet, and ethyl violet) and the yellow colouring matter

known as flavine or diaminomethylacridinium chloride.



The latter was originally tried by Ehrlich on trypanosome infections, and was found to have a very marked therapeutic effect.

The authors claim that whereas the bactericidal action of flavine is stimulated by the presence of serum (*Staphylococcus aureus* is killed in dilution of 1 : 20,000 in water, but in 1 : 200,000 in serum), its power of inhibiting phagocytosis is not high, a concentration of 1 : 500, as compared with 1 : 625 for chloramine-T, 1 : 13 for eusol, and 1 : 9 for Dakin's solution, being required. For a true comparison, however, it is necessary to determine the relation of the bactericidal action (*i.e.* the minimum strength of solution required to kill the bacteria) to the phagocytosis action (*i.e.* the strength of antiseptic required to reduce the number of leucocytes to half that of the pure serum control), and this ratio, which the authors call the therapeutic coefficient, is much higher than that given by any of the older antiseptics or the dyes referred to. The irritating effect was compared by placing three or four drops of the solution on the conjunctiva (rabbit) for three minutes. Flavine produced no effect in a concentration of 1 : 200, mercuric chloride 1 : 500, and chloramine-T 1 : 25. It thus appears that though flavine does not compare very favourably with chloramine-T in its irritant action, or with the absolute values of the hypochlorites in phagocytosis, its interest appears to lie in its exceptional bactericidal properties, and more especially in the enhanced effect said to be produced by the presence of serum.

The value of the antiseptic seems to centre round this fact, and it will be interesting to learn what special property attaches to flavine whereby it is able to destroy bacteria, whilst not only leaving untouched, but materially activating the antiseptic properties of serum.

In summarising their results, the authors claim that flavine has been found to possess extremely powerful bactericidal and antiseptic properties, which are enhanced rather than diminished by admixture with serum; that in presence of serum flavine is the most potent bactericide of all those investigated for both Staphylococcus and *B. coli*, and it is equally efficient for the enterococcus and for anaerobes, such as *B. oedematis maligni*; that flavine, in relation to its bactericidal power, is very much less detrimental to the process of phagocytosis and less harmful to the tissues than the other substances; hence much higher effective concentrations can be employed without damaging the tissues or interfering with the natural defensive mechanisms. The clinical observations recorded by Dr. Ligat and others at the Middlesex Hospital are very encouraging, and hold out the promise of an extended use of the new antiseptic. It will now be necessary to find a means of supplying the antiseptic at a reasonable cost. J. B. C.

THE SCHOOL OF ORIENTAL STUDIES.

THE daily papers have given a full account of the formal opening, on February 23, of the new School of Oriental Studies in Finsbury Circus, and have reported Sir John Hewett's loyal address, the gracious reply of his Majesty the King, and Lord Curzon's speech describing the objects and ambitions of the school. A brief mention of an occasion so historic seems to be called for even in the pages of a scientific journal. We are interested in all sound and scientific teaching, and the teaching of Oriental languages may ultimately affect the progress of science in Asia and Africa.

It has been objected that the opening of a new and expensive school, costing 14,000*l.* a year, besides the expense of adding a fine block of classrooms to the old London Institution, was not very consistent with the economies which war has imposed upon us. The answer to this objection is easy and, indeed, obvious. The scheme to establish an Oriental school in London fitted to be a rival of the famous schools in Berlin, Petrograd, and Paris was set on foot ten years ago, and the funds now expended were promised or given before war broke out. Moreover, war has opened our eyes to the necessity of making an effort to compete vigorously with the activities—political, commercial, and even scientific and linguistic—of the Germans in Asia and Africa. We have discovered that their industry was rarely disinterested, and that political propaganda was too often at the root of "peaceful penetration" in the field of missionary, scientific, and linguistic effort.

Even if that were not the case, it was a reproach and a shame to us that our present enemies had all but secured a monopoly in Oriental learning. Our own Oriental scholars looked to Berlin for recognition, instruction, and aid. Many of them are justly proud of German honorary degrees conferred upon them at a time when Germans were admittedly at the head of the Indianists of the world. They pursued and rewarded not only the classical learning of the East, but the newer studies, ethnological and linguistic, which are scarcely known to our own universities. It was an Austrian priest, Pater Schmidt, who discovered that the speech of the Khasis in Assam, once supposed to be as unique and isolated as that of the Basques in Europe, in fact extends right across the Pacific Ocean to Easter Island. It was in Germany that all the best research was done, all the most learned periodicals printed. It was the Germans who inherited the tradition of Oriental learning set up by Sir William Jones. It was time that this monopoly should be contested.

It is to be hoped that the new school will act in concert with indigenous scholars in India.

Many of these are endeavouring to make the greater India languages fit vehicles for the imparting of scientific teaching. For example, the Vangiya Sahitya Parisat, a learned society in Calcutta, has for some fifteen years past been compiling a vocabulary of chemical and botanical terminology in the vernacular. This is a task in which the help of Western scholars is plainly required, lest there should be misunderstandings and overlapping of effort. So is it also in the field of comparative philology, in which native students are apt to ignore the acquisitions of Western scholarship.

Finally, H.M. the King was happily inspired in suggesting that the pupils of the school may hereafter be "teachers of unselfish government and civilised commerce." Scholarship and science should be disinterested, while commerce should be a loyal and friendly exchange to the benefit of both parties to the transaction. It was, once more, time that the great City of London should recognise that a sound and scientific knowledge of Asiatic and African languages, literary and other, is a necessary part of the extension of British influence in lands where our sole object is to improve the social and physical condition of races which have fallen behind our own standard of civilisation.

At the opening of the school the King was accompanied by the Queen and Princess Mary. On arriving at the school their Majesties were received by Lord and Lady Curzon and Sir John Hewett, chairman of the governing body. The opening ceremony took place in the library, where Sir John Hewett, addressing the King, said they took the King's presence as a sign that his Majesty was fully cognisant of the importance to the Empire of the study of Oriental and African languages and civilisations on a scale which Great Britain, alone among great countries of the world interested in the East, had not hitherto regarded as necessary; and they had planned that the school should be at least equal to the Oriental schools in foreign capitals, and adequate to Imperial needs.

The King, in the course of his reply, said: "I am glad to be the patron of the School of Oriental Studies, and it gives me particular gratification to take part to-day in the ceremony of opening this fine building in which the school is henceforth to carry on its work.

"I cannot sufficiently emphasise the wide scope and vast importance of that work. The school will afford fresh opportunities of study to those services which have been the pioneer of progress and the instrument of good government in India and Egypt. It will furnish with a fuller technical equipment the pioneers of commerce and industry who in each successive generation undertake the duty of upholding the honoured fame of British trade in the East. Its work will serve to develop the sympathy which already so happily exists between my subjects and those of my Far Eastern ally, Japan. But more than this is to be looked for from the school.

"If it happily succeeds in imparting to the pupils sent out as teachers of unselfish government and civilised commerce a clearer comprehension of the thoughts and lives of the diverse races of the East, the good effects of that success will extend far beyond the immediate and tangible results. The ancient literature and the art of India are of unique interest in the history of human endeavour. I look to the school to quicken public interest in the intellectual tradition of that great continent and to promote and assist the labours of the students in these departments of knowledge, to the mutual advantage of both countries."

After the termination of the proceedings their Majesties inspected the new school. They were accompanied by the Lord Mayor, Lord and Lady Curzon, Mr. H. A. L. Fisher, Sir John Hewett, Mr. P. J. Hartog, and Dr. Denison Ross, the director of the school.

GEORGE MASSEE.

MYCOLOGISTS in all parts of the world will learn with great regret of the death of Mr. G. Massee, which occurred at Sevenoaks, on February 17, after a brief illness. George Edward Massee was born at Scampston, in Yorkshire, about 1850, and at the age of ten was sent to school in York. He early showed a taste for drawing and natural history. At the York School of Art he gained the national medal for the year, and when about seventeen years old published a paper on woodpeckers in the *Intellectual Observer*. Later he studied botany under Spruce, a relative of his mother. It was intended that he should follow his father's steps as a farmer, but, always ready for adventure, he readily accepted Spruce's suggestion to visit the West Indies and South America. He travelled in both the eastern and western countries of that continent, and, in addition to making botanical collections, sent home living plants in bulk.

On his return Massee's artistic talent became further manifest through the publication of his drawings in Spruce's "Hepaticæ Amazonicæ et Andinæ." He took up teaching and returned to the study of botany, specialising in fungi and plant diseases. He also got into touch with the late Dr. M. C. Cooke, and after working as a volunteer at Kew for some years he succeeded Cooke in 1893 as head of the Cryptogamic Department of the Herbarium, a post which he held until his retirement in 1915.

Amongst his earlier volumes may be mentioned "British Fungi, Phycomycetes and Ustilagineæ" (1891), and "A Monograph of the Myxogastres" (1892). Between that year and 1895 four volumes of his "British Fungus Flora" were issued, the work remaining incomplete. The descriptions in this flora were detailed and comprehensive, and the book has proved indispensable to all British students.

Massee's serious pathological investigations began about 1895, and from that date until his retirement a continuous stream of contributions to this subject flowed from his pen. His "Text-book of Plant Diseases" (1899), in which he made a wise selection from the best work of others, was a really good and useful book, and had perhaps a higher reputation than any other. Its publication marked a distinct epoch in the history of plant pathology in this country. In his larger work, "Diseases of Cultivated Plants and Trees" (1910), many of the author's own views, not always

shared by others, are included. As a work of reference the later treatise is, however, unique and invaluable. In spite of his energies in the field of pathology, taxonomy still received attention, as is testified by the volumes, "European Agaricaceæ" (1902), "British Fungi and Lichens" (1911), and "British Mildews, Rusts, and Smuts" (1913). Massee was a fellow of the Linnean Society from 1895 to 1915. He was elected an associate in 1916. In 1902 he received the Victoria Medal of Horticulture of the Royal Horticultural Society.

Massee's talent as a systematist lay perhaps mostly in his genius for recognising the affinities of a fungus and his remarkable memory. He wrote fluently and forcibly, and being full of energy and industry, was therefore an extremely rapid worker. His artistic powers were quite exceptional, and his drawings, many of which were extraordinarily beautiful, were usually executed with astonishing rapidity. His power of recalling the precise appearance of individual specimens was so great that he could with the greatest ease portray from memory a whole series of Agarics or other fungi. As to detail he was impatient, his style being always bold and vivid. Massee was a remarkable personality. Quick, shrewd, and outspoken, he was misunderstood by some. Those who knew him well understood and appreciated him, and mourn the loss of an old and valued friend. A. D. C.

THE PROMOTION OF TECHNICAL OPTICS.

THE attention of all interested in the subject of technical optics, the importance of which we have emphasised repeatedly during the last few years, is directed to the subjoined valuable and interesting report, issued by the Board of Scientific Societies, having been approved by the Board on January 24. It will be recalled that the board was formed some time ago by the Royal Society after conferences with the learned and professional societies of the kingdom with the object of investigating scientific and technological problems arising out of the war. It is an additional testimony to the importance of the subject that this should be the first formal report issued by the board.

The committee upon whose labours the report is based was exceptionally well qualified to deal with its reference "to consider and report upon national instruction in technical optics." It comprised well-known representatives of the scientific, the industrial, and the educational aspects of optics, and included a high official of the Ministry of Munitions, which has had such good cause to realise thoroughly the disasters brought upon the nation by previous neglect.

The report is, we think advisedly at this stage, not overburdened with details, but deals with the matter in hand on broad lines, both as to the necessity for immediate action and the direction that action should take, but we are pleased to note that the "committee is willing," and, we assume, prepared, "to give further advice with respect to . . . matters connected with subjects referred to in the report."

The necessity for immediate action is emphasised in weighty sentences, especially in regard to the numerous scientific and industrial interests involved. The report asserts that "the next few years are the years which will determine the future of the [optical] industries of the country."

The actual recommendations for action are directed towards concentration and appear to focus on two points—the provision of the "man" and of the "home"—though other matters of outstanding importance are not overlooked. The first point can be dealt with without any great delay by the appointment of a "director," as he is provisionally termed, whose initial duty will be the organisation and direction of the whole of the teaching, and who, assisted by a qualified staff, should, from the start, be able to advise "the trade in any difficulties they may encounter" until "a sufficient supply of men thoroughly trained" can be evolved. But such an appointment involves an appointing body, and this the board proposes to set up in the form of an independent "supervising representative council," which, although it is sometimes referred to as an "advisory council," obviously must have executive powers and the control of funds, and, presumably, would be a statutory body, although the report does not say so. It is strongly advocated that the council should be independent of any existing institution or governing body, as dependence would seem "to perpetuate what . . . should only be a transitional stage." Similarly, the director should not be a member of the staff or responsible to the governing body of any existing institution.

One of the dangers which the board appears to anticipate in too close a connection with, say, the Imperial College is the tendency to allocate all higher research to the favoured college. But higher research in any subject, and not least in such a subject as optics, grows naturally out of opportunities and predilections in any suitable soil, and it would be a mistake to endeavour to confine it to any one college or institution, especially if the favoured place has already many wider and diverse interests in other directions. The recent history of research in this very subject illustrates the point. We need only refer to what has been accomplished by Prof. H. Jackson at King's College, London, by the University of Sheffield, and by the Glass Research Committee of the Institute of Chemistry. Such researches are essentially strongly individualistic and not made to order, whilst, for the organised research involved in the investigation of particular industrial problems, there is the National Physical Laboratory created for this very purpose.

The other point referred to above—the provision of a "home"—is regarded by the board as of vital importance, and to be proceeded with "as soon as the preliminary work of organisation permits."

Such a home, provided not only with lecture-rooms and laboratories, but also with meeting-places for societies, traders, and students, and especially with an adequate library, "would concentrate the efforts of all who are concerned with the manufacture or use of optical instruments." We have ourselves more than once advocated such a project, and it is to be hoped that those entrusted with the administration of the large public funds which are, and will be, we hope, more in the future, devoted to similar objects, will not, as in a scheme criticised in the report, take the line of least apparent resistance and relegate the establishment of an optical institute to the dim and distant future. Such a course would be, we assert, simply disastrous. It may not be inopportune to recall that the establishment of such an institute received, only a few months ago, the cordial approval of the present Prime Minister, who was doubtless influenced by his experience as Minister of Munitions.

Space does not permit us to dwell in detail on other valuable suggestions in the report, but there is one of great importance which may be mentioned in conclusion. We refer to the provision of suitable optical text-books, the translation, in the first instance, of suitable foreign books, and to the abstracting of important publications on technical optics.

NATIONAL INSTRUCTION IN TECHNICAL OPTICS.[1]

SEVERAL attempts have been made during recent years to provide systematic training in technical optics, and a scheme prepared by the London County Council will be referred to in this report. But, before discussing the details of any proposals, it is advisable to form a clear conception of the requirements of the optical trade, and of the organisation of the teaching best adapted to promote the interests of that trade without regard to existing conditions, which no doubt will place some difficulties in the way of the immediate adoption of a thorough-going and satisfactory scheme.

It is necessary at the outset to emphasise one point which is of vital importance. If a perfect organisation for instruction and research in optics could instantaneously be called into being, some years would necessarily elapse before the trade would appreciably benefit by it, because that trade requires above everything a sufficient supply of men thoroughly trained in the scientific principles underlying the proper construction of optical appliances. Such men are not obtainable at the present moment; they will have to be trained, and this requires time. But the next few years are the years which will determine the future of the industries of the country. To avoid a delay which might prove fatal, it is essential that provision should be made at once to give the trade such assistance and advice as will ultimately be supplied by the body of trained men which, it is hoped, will be available in a few years.

This leads us to our first recommendation. Whatever scheme be adopted, it is essential that it should include the appointment of a highly qualified scientific man, who will be charged with the organisation and direction of the whole of the teaching. This man, to whom we shall refer as the "director"—whatever title he may subsequently receive—ought to be appointed at once. Among the duties specially assigned to him in the preliminary period should be that of advising the trade in any difficulties they may encounter. A sufficient staff should be assigned to him for the purpose. The director should not be attached exclusively to any of the existing institutions.

A further need, which is urgent, is the supply of standard text-books dealing with those parts of optics which at present are greatly neglected in this country; this includes practically the whole of geometrical optics and a large part of technical optics. In our opinion, the quickest and most effective manner of dealing with this requirement is by publishing translations of existing foreign books and abstracts of important papers on the subject.

In defining the range of teaching to be provided, and forming an estimate of the number and type of the students who may avail themselves of the opportunities offered, we must keep in mind that the use of a knowledge of optics is not confined to those intending to enter the optical trade. The Army, the Navy, the Patent Office, and other Government departments employ optical experts. We are informed that the Royal Naval College habitually sends some of its ablest young officers to an optical firm, to be instructed in the principles and designs of range-finders, gun-sights, and other optical instruments. Medical men, bacteriologists, surveyors, and nautical men would also, in many cases, welcome instruction in special branches of optics. We may here refer to the School of Economics, an institution mainly devoted, as its name implies, to a highly specialised branch of knowledge, which derives its practical importance from its connection with matters affecting the welfare of the country. In these respects, it presents a certain analogy with the proposed school of optics. Experience in this case shows that the instruction given has attracted, from much wider circles than was originally contemplated, students desiring instruction in special departments of economics. It is, therefore, well not to take too narrow a view, but to look upon the practical application of optics as being one of the many points of contact between the industries and pure science. Any advance in its study will hence react beneficially on the advance of the science on which it is based.

We therefore look forward to the establishment of an optical institute which would concentrate the efforts of all who are concerned with the manufacture or use of optical instruments. It would bring together the several optical societies, which might find a home within its building; it would be the centre for the co-operation of the trade with students and teachers; it should contain a library with periodicals and books on optics.

The general direction of the courses of study should—as is the case in the scheme of the London County Council—be vested in an Advisory Council on which the trade, as well as the optical and learned societies, is represented. It has already been insisted upon that there should be a principal or director who is highly qualified on both the theoretical and the practical side, and who would be responsible to the Advisory Council. Full courses of instruction, in both day and evening classes, will be required. The day departments would consist mainly of youths between the ages of fifteen and twenty, who would receive general and technical instruction, including mathematics, physics, chemistry, and practical optical work.

The evening work would be adapted to the requirements—

(1) Of students engaged in the trade during the daytime;

(2) Of advanced students, some of whom would have

[1] Report approved by the Board of Scientific Societies of a Sub-Committee consisting of Mr. Conrad Beck, Mr. F. J. Cheshire, Mr. E. B. Knobel, Sir Philip Magnus, Prof. H. Jackson, and Prof. A. Schuster (chairman).

graduated in science, and would be preparing to occupy the position of managers in optical works;

(3) Of other persons interested in learning the scientific construction or use of optical instruments.

Provision should be made for research work not requiring a highly specialised or expensive plant. Special investigations might be referred to the National Physical Laboratory, or any other laboratory suitable for the purpose.

It is also worth considering whether a good journal or paper should not be published, devoted to scientific instruments and other matters concerned with optics.

We are aware of the difficulties which stand in the way of putting into immediate operation a scheme which would satisfy in a comprehensive manner all the above conditions. It will therefore be necessary to contemplate a transitional period leading up to what we ultimately hope to obtain.

In considering the provisional arrangements, regard must be had to the fact that already some very good work in the training of operatives of different classes is being done at the Northampton Polytechnic Institute, where a certain amount of modern machinery and apparatus has been provided, and young men and women are receiving useful training, the value of which has been recognised by the Government. We may also direct attention to the valuable research work being carried out in King's College, London, under the Glass Research Committee of the Institute of Chemistry. The instruction given at the Northampton Institute should, however, at once be supplemented by more advanced teaching in some convenient institution of university rank. Stress has already been laid on the immediate appointment of a principal or director, and there is no reason for delaying the formation of the Advisory Council. So soon as the preliminary work of organisation permits, plans should be prepared for a new building, which, in our opinion, is essential.

The scheme of the London County Council represents a carefully considered attempt to utilise and extend the teaching given in existing institutions, and to reconcile conflicting interests. Its object is, therefore, the same as that which we contemplate in the transitional period, and in its main features it seems to differ little from our proposals. It is not with the object of making any captious criticism, but merely to prevent possible misunderstanding, that we desire to point out what seem to us to be serious defects in the details of the scheme.

It is provided that the Imperial College of Science should institute a separate Department of Technical Optics, with a head who is also to exercise some undefined powers of general supervision over the whole scheme. Being a member of the staff of the Imperial College, he would presumably be appointed by the governing body of that institution, and primarily be responsible to it. He would have at the same time powers over the course of instruction at another institution that had no voice in his appointment. His relationship to the Advisory Council is not defined, and the proposal in its present form does not seem to us to be conducive to harmonious working. It also seems to perpetuate what, in our opinion, should only be a transitional stage. Our own proposal contemplates that the appointment of the Director of Studies should be primarily vested in whatever body is constituted as the main governing body.

Another fundamental defect of the scheme is implied in the wording defining the distribution of the work between the Imperial College and the Northampton Institute. Stress appears to be laid on post-graduate work conducted at the Imperial College, and research work is confined to that institution. If it be meant that the normal course of instruction should begin with a degree course in pure science, and the higher technical teaching should only begin after such a course is completed, we must express our dissent from that view. There may be some cases, no doubt, where a graduate in science will turn his mind towards technical optics, and provision should be made for him; but the centre of gravity of the institution must be a course extending over two or three years, in which teaching in science is, *ab initio*, directed towards the necessities of its optical applications. As regards research work, the teachers in any institution which may be built or during the transitional period at the Northampton Institute, should be of sufficient standing to be able to conduct research work, and though no expensive or elaborate plant need be supplied, and such research work need not form a prominent part of the activity of the institute, it is not advisable to lay down any hard-and-fast lines as to where researches are to be carried out. Special investigations, as has already been said, will probably be largely concentrated at the National Physical Laboratory, but they also should not necessarily be confined to any one place.

In conclusion, we may sum up the requirements which appear to us to require immediate attention:—

(1) The appointment of a supervising representative council.

(2) The appointment, under the proposed supervising council, of an administrating director, with special duties during the transitional period, which will include advice to the trade and the organisation of the different parts of the curriculum.

(3) The translation of suitable works and the abstracting of other important publications on technical optics.

(4) Pending the erection of a suitable building, the organisation of day and evening courses at the Northampton Institute, and arrangements for higher instruction at some other institution of university rank.

The term "technical optics" throughout the report is intended to include the chemical composition and manufacture of glass

The committee is willing to give further advice with respect to the selection of books for translating or abstracting, and any other matters connected with subjects referred to in the report.

NOTES.

WE notice with much regret the announcement of the death, at seventy-four years of age, of Prof. J. G. Darboux, permanent secretary of the Paris Academy of Sciences, professor of higher geometry at the Sorbonne, and a foreign member of the Royal Society.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Dr. J. H. Ashworth, Mr. L. Bairstow, Prof. G. A. J. Cole, Mr. C. F. Cross, Dr. H. D. Dakin, Prof. A. S. Eve, Prof. H. Jackson, Prof. J. S. Macdonald, Prof. J. W. Nicholson, Dr. R. H. Pickard, Mr. C. T. Regan, Dr. R. Robertson, Dr. E. J. Russell, Mr. S. G. Shattock, and Prof. F. E. Weiss.

THE *Times* announces the death, on February 24, of Prof. Jules Courmont, professor of hygiene and deputy doyen of Lyons University.

MR. W. H. H. JESSOP, senior ophthalmic surgeon to St. Bartholomew's Hospital and president of the Ophthalmological Society of the United Kingdom, died on February 16 at the age of sixty-four. In 1885, soon

after the introduction of cocaine by Koller, he investigated the action of this drug upon the eye. He devoted himself chiefly to the clinical side of his subject, and with great success. He was a member of several foreign ophthalmological societies and a constant visitor to international congresses. In this manner he became well known amongst Continental ophthalmic surgeons, and they were always made welcome as his guests. At the time of his death he was engaged upon two very important projects. The foundation of a really representative *British Journal of Ophthalmology* has already been successfully accomplished, chiefly as the result of his energy and enthusiasm. He was also actively promoting the affiliation of certain provincial ophthalmic societies with the London Society. Mr. Jessop was a lover of the arts, and his collection of Whistler prints is unique.

By the death, in his seventieth year, of Dr. J. F. Fleet, India has lost one of the most learned members of the Civil Service. At an early period of his career in the Bombay Presidency he acquired a profound knowledge of Sanskrit and of the local dialects, particularly of the ancient Kanarese. His most important work, published in 1888, was vol. iii. of the "Corpus Inscriptionum Indicarum," in which, for the first time, the chronology of the Gupta period, one of the most difficult problems in the history of ancient India, was finally settled Besides numerous papers in scientific journals, he contributed the article on epigraphy to the last edition of the "Imperial Gazetteer of India," and those on "Hindu Chronology" and "Indian Inscriptions" to the eleventh edition of the "Encyclopædia Britannica." He also engaged in the controversy, not yet finally settled, on the date of the Kushan Emperor Kanishka.

By the death of Mr. R. H. Tiddeman on February 20, we have lost a field geologist of long experience and rare sagacity. Born on February 11, 1842, he was appointed by Sir R. Murchison an assistant geologist on the Geological Survey of the United Kingdom in 1864. He was promoted to geologist in 1870, and retired in 1902. For more than twenty years Tiddeman was engaged in surveying the Carboniferous rocks of Westmorland, Lancashire, and Yorkshire, and during this period he made the observations which enabled him to lay before the Geological Society in 1872 a classic paper of far-reaching consequence on the evidence for an ice-sheet in those counties. Later on he was temporarily engaged in North Wales, where he determined the Carboniferous age of some red rocks in the Vale of Clwyd, which had previously been regarded as Trias. From 1895 until his retirement he assisted in surveying the southern part of Glamorganshire. He was author of the Geological Survey memoir on the water-supply of Oxfordshire, a task for which his residence at Oxford after his retirement proved convenient, and was editor and in part author of the memoir on the Burnley coalfield. Contributions were furnished by him to upwards of nine other memoirs dealing with the north-west of England and North and South Wales. In his unofficial work his investigations in the Victoria Cave, and his philosophic work on reef-knolls and succession of episodes in the Carboniferous limestone, take first place. His views on the relative age of the deposits of the Victoria Cave and the Boulder Clay were long in receiving the appreciation due to them. In 1911, partly in consideration of his long record of useful work, but especially in recognition of his observations on the fauna and structures of reef-knolls, he was awarded the Murchison medal. He was elected president of the Yorkshire Geological Society in 1914, and served on the council of the Geological Society of London in 1905–10. He leaves a widow and two daughters.

The Minister of Munitions, after consultation with the Admiralty and the Home Office, has appointed two committees—an owners' committee and a workmen's committee—to deal with certain problems connected with the Scottish shale industry. Prof. John Cadman will represent the Ministry, and will act as chairman of the two committees when they meet in joint session. Sir George Beilby has been appointed to act as technical adviser, and Mr. Hugh Johnstone will be a member of the committee and act as secretary.

The annual general meeting of the Institute of Metals is to be held on Wednesday, March 21, and Thursday, March 22, in the rooms of the Chemical Society. The meeting on the Wednesday will commence at 8 p.m. and that on Thursday at 4.30 p.m. A special feature of the meeting will be a general discussion on metal melting, over which the president of the institute, Sir George Beilby, the head of the new Government Board of Fuel Research, will preside. The seventh annual May lecture of the institute will be given at the Institution of Civil Engineers, Great George Street, Westminster, on May 3, at 8.30 p.m., by Prof. W. E. Dalby, on "Researches made Possible by the Autographic Load-Extension Optical Indicator."

An important programme of mining development is being undertaken by the Duchy of Cornwall, the principal object being the recovery of wolfram. This mineral is at present in great demand for the production of tungsten, a metal which constitutes from 18 to 20 per cent. of the modern high-speed cutting tool. The scene of the operations is on the extreme eastern edge of Cornwall, a few miles to the west of Tavistock, and the work on which the Duchy is engaged falls into three parts. The first is at Kit Hill, which forms the westerly part of Hingston Down, and rises nearly 1100 ft. above sea-level. Here a cutting is being driven north and south across the surface of the hill. For the greater part of the course it runs through granite, and in this section it has cut through a number of promising lodes of wolfram and tin. These lodes, which run roughly east and west, are vertical, and contain a varying number of veins of mineral. The largest disclosed so far is about 20 ft. wide. The second area on which the Duchy authorities are working is further east on Hingston Down. At the Plantation shaft a considerable quantity of wolfram has been blocked out, and work is to be pressed forward vigorously. The third part of the enterprise is represented by the mine and ore-dressing works at Gunnislake Clitters, situated on a steep bank beside the river Tamar, a mile or so from the Hingston Down Mines. Work will be resumed on the mine in due course, but at present attention is being paid to the remodelling of the mill, which stopped work in 1909, being idle until recently, and consequently deteriorated.

The extent to which aluminium, which thirty years ago was merely a scientific curiosity, has become a war metal of the first importance is well illustrated by a recent order made by the Minister of Munitions under the Defence of the Realm Acts and the Munitions Acts, requiring that all persons shall in the first seven days of each month, beginning in March, send in to the Director of Materials, Hotel Victoria, S.W., monthly returns of all aluminium (*a*) held by them in stock or otherwise under their control on the last day of the preceding month; (*b*) purchased or sold by them for future delivery and not yet delivered on such last day; (*c*) delivered to

them during the preceding month; (*d*) scrap or swarf produced by them. No return, however, is required from any person whose total stock of aluminium in hand, and on order for future delivery to him, has not at any time during the preceding month exceeded 56 lb. The variety of uses in which aluminium now finds application is shown by the fact that for the purpose of the order the expression includes ingots, notched bars, slabs, billets, bars, rods, tubes, wire, strand, cable, plates, sheets, circles, and strip. The Air Service claims in one way or another at the present time the bulk of the aluminium production. It is interesting to note, as a temporary phase of the disturbances caused by the war, that a number of aluminium transmission lines were taken down in the latter part of 1915 and replaced by copper.

MR. G. F. HILL contributes to vol. xxxvi., part ii., of the Journal of the Hellenic Society, 1916, an elaborate paper on Apollo and St. Michael. He finds a parallelism between them as destroyers of an evil principle, as light controlling darkness, as the controlling agency of plague. Incidentally, he protests against the common view that the worship of saints is always a mere relic of paganism. There is no doubt that the medieval or modern worship is often engrafted on an old pagan stock, and the choice of the stock may have been assisted by some likeness of name or other association. "But the fact that we must not lose sight of is that, even had the pagan worship never existed, medieval Christianity was perfectly capable of inventing its own cults and legends."

THE Journal of the Bihar and Orissa Research Society is doing excellent work in examining the manners and customs of the forest tribes of the province. In vol. ii., part iii., the Santals, with their peculiar marriage customs, receive special attention. Among them, according to the Rev. P. O. Bodding, "the original, and even now theoretically accepted, idea of woman seems to be that she is a kind of irresponsible and untrustworthy being, a necessary and useful, but somewhat inferior, member of human society." The Birhors, according to Mr. Sarat Chandra Roy, have an elaborate totemistic system, one peculiar feature of which is the belief in the magical power of certain clans over wind and rain. But the tribe is not at the present day organised, like the Arunta, as a co-operative supply association, composed of groups of magicians, each group charged with the management of particular departments of Nature. Birhor totemism has little influence on the growth of their religion, but its most noteworthy feature appears to be the belief in the vital connection between the human clan, their totem, the hill which is reputed to have been their original home, and the presiding spirit of this hill.

THE Annals of Tropical Medicine and Parasitology for February (vol. x., No. 4) contains two lengthy papers on intestinal protozoa. The first, by Messrs. Malins Smith and Matthews, deals with these organisms in 250 non-dysenteric cases, of whom twenty were found to be carriers of the dysenteric amœba. The second, by the same observers, together with Mr. H. F. Carter and Dr. Doris Mackinnon, discusses the protozoal findings in 910 cases of dysentery examined at the Liverpool School of Tropical Medicine, of whom 410 were found to have protozoal infections. Of these, ninety-four were infected with the dysentery amœba, 231 with the non-pathogenic *Entamoeba coli*, and 207 with other protozoa. In some of the cases double and triple infections existed.

MR. E. E. LOWE, the hon. secretary of the Museums Association, has for some time past been endeavouring to induce glass manufacturers in this country to take up the production of rectangular glass jars, such as are used in museums and other scientific institutions, since these have hitherto been made in Germany. The results of his labours in this good cause, which have been by no means light, he gives in the *Museums Journal* for February. Messrs. Baird and Tatlock alone have responded to the invitation to supply our needs in this direction. This they have been induced to do as the result of undertakings secured by Mr. Lowe from institutions in this country, India, and America. France, South Africa, and Australia will also, it seems, be glad to turn to this country for their needs in this regard, so that the demand for jars of this description should justify the initial outlay in the matter of making the moulds, the high cost of which has served as a deterrent with other manufacturers. To save this trade from falling again into the hands of the Germans it is to be hoped that all institutions using these jars will, as soon as possible, place orders with Messrs. Baird and Tatlock to encourage them in their venture.

IN a pamphlet entitled "The High Price of Sugar and How to Reduce It" (London: Bale, Sons and Danielsson, Ltd.; 1s. net) Mr. Hamel Smith, editor of *Tropical Life*, directs attention to one of the results of our failure to think out and put into operation in normal times an Imperial scheme for providing necessary supplies of food. There was perhaps some excuse for our failure to encourage the production of corn and meat in this country, but there was none for our neglect to stimulate the production of such materials as sugar in our tropical possessions before the war. The fact of our dependence on foreign countries for sugar was notorious long before the war, yet practically nothing was done, nor apparently is anything of great importance being now done, to alter this state of things. Almost everywhere throughout the Empire where sugar is grown the yields are low, the chief causes being failure to grow the best canes available, neglect of intensive cultivation, and adherence to obsolete methods of manufacture. Perhaps the most notorious case is that of India, which, with 2,500,000 acres under sugar-cane, is able to produce only 2,600,000 tons of inferior cane-sugar, an average production of about one ton per acre, against a production of about four tons per acre in Java and nine tons per acre in Hawaii. Mr. Smith's proposals briefly are that the improvement of cane cultivation and of sugar-cane manufacture should receive immediate attention from the Imperial, Colonial, and Indian Governments, and he shows that we could without difficulty produce within the Empire all the sugar we require and have a considerable surplus for export.

IN a paper published by the Commonwealth Bureau of Meteorology (Bulletin No. 14) Dr. Griffith Taylor makes a contribution on somewhat novel lines to the much-debated question of acclimatisation. The paper, which is entitled "The Control of Settlement by Humidity and Temperature," discusses the limits of comfortable settlement for the white races. This, Dr. Taylor maintains, is decided mainly by the humidity and wet-bulb temperature. Other elements are rainfall and wind velocity, but as the present investigation deals with colonisation from the point of view of comfort rather than from that of wealth, the influence of rainfall has been omitted. Dr. Taylor has drawn a graph with the twelve monthly means of wet-bulb temperatures and relative humidity at a given place plotted as a twelve-sided polygon, with wet-bulb ordinates and humidity abscissæ. This he terms a climograph. In height and area the climograph shows the range of

temperature. In order to find the typical white climograph the author takes five towns in the southern, and seven in the northern, hemisphere, where white energy appears at its highest development. The resulting figure he uses as a criterion in all the climograph charts. He then takes Herbertson's natural region and draws a typical climograph for each, which in every case is compared with the white climograph. Applying the results more particularly to Australia, Dr. Taylor confirms the generally accepted opinion that the hinterlands of tropical Australia can develop only on pastoral lines, and that the coast lands of the north are useless for white settlement. The paper is a valuable scientific reply to the advocates of a white Australia.

METEOROLOGICAL information of a varied character is given in the Quarterly Journal of the Royal Meteorological Society for January. Among the papers communicated are "A Meteorologist in China," by C. E. P. Brooks; "Discontinuities in Meteorological Phenomena," by Prof. H. H. Turner; and a lucid communication by Sir Napier Shaw, director of the Meteorological Office, on "Meteorology for Schools and Colleges"; also a communication on "The Measurement of Rainfall Duration," by Carle Salter, assistant-director, British Rainfall Organisation. Records from self-recording gauges for fifty-eight stations scattered over the United Kingdom are as yet obtainable. Many of the records are for a short period, for a year or two only, and the recording gauges are of various patterns. The author acknowledges that many difficulties have to be contended with and he hints that possibly a standard type of recording instrument may eventually have to be insisted on, in the same way as in official sunshine returns. Mr. Salter has done good work in dealing with the method and preliminary difficulties encountered. A discussion on "The Forms of Clouds," by Capt. C. J. P. Cave, R.E., is of considerable interest. The paper is illustrated with beautiful photographs of the forms of cloud, and the author explains the different forms, and combats freely the forms suggested by many earlier writers on the subject. Much information is given on the different layers of air and the measurements of the heights of clouds. This cloud paper is in many ways suggestive to the would-be observer.

WE have received from Messrs. Flatters and Garnett, Ltd., Oxford Road, Manchester, a specimen of their cedarwood oil for use with oil-immersion microscopic objectives. As the result of tests we find that the oil is of good consistence and colour, does not become cloudy in cold weather, and has a high refractive index. The refractive index is stated to be 1·510, but that of the specimen sent to us was well above this, viz. 1·518. Immersion oil has hitherto been supplied from the Continent, and we are glad to direct attention to this British-made oil, which seems to fulfil every requirement. It is supplied in bottles at from 9*d.* to 4*s.* each, or in bulk.

THE sixth part of vol. v. of the Transactions of the Royal Society of South Africa contains a paper by Prof. J. C. Beattie, of Cape Town, in which are embodied the whole of the determinations of the deviation of the compass from true north and of the magnetic dip at 667 stations in South Africa. The two large maps show that the lines of equal deviation run across the country from north-west to south-east, the greatest deviation—27° to the west—occurring at the south-western corner of the country near Cape Town, and the least—14° west—at Beira. The lines of equal dip run from south-west to north-east in the south-eastern portion of the country, and show a tendency to run more nearly east and west in the northern districts. The dip is nearly 63° south in the south-east near East London, and diminishes to 52° south in the neighbourhood of the Victoria Falls in lat. 18° south. During the last ten years the deviation to the west has decreased a degree and a half to two degrees, while the dip has increased by a degree or a degree and a half.

PROF. MACMILLAN BROWN, in a recent number of the *Press* of New Zealand, discusses the appearance and disappearance of islands amid the western insular fringe of the Pacific. He recognises two curves of vulcanism, an outer, extending from the Aleutian Islands to Malay and New Zealand, and an inner, passing through the Marianne, Caroline, Gilbert, Ellice, Samoa, Tahiti, and Paumotu archipelagos to Easter Island. The outer curve lies off the enclosing continental shelf of the ocean, while the inner curve is parallel with the trend of the ancient continental shelf. The "main longitudinal crescent of vulcanism" has shifted from the inner to the outer curve, and with this shifting much archipelagic land between the two curves has disappeared. The main interest of the theory lies in the suggestion that this shifting has taken place in human times. The elevation of Rota in the N. Mariannes is dated to the Japanese Bronze age, 4000 years ago, by bronze bosses in the elevated coral. Ocean Island has risen and sunk several times, and in a previous elevation was inhabited by Polynesians, who made the regular Maori ovens. Ponape is supposed to have been a central point in a large archipelago with a great population. A considerable forest area with a dense population is required to account for the megaliths of Easter Island. In any case, those who speculate on migration routes must not assume as their basis the same areas and distribution of land in the Western Pacific as now exists. Prof. Brown, if the subsidence theory of atoll formation (which he assumes to be the only applicable theory) is applicable to the Western Pacific, must find much further and more direct evidence of those great archipelagos which he postulates as existing such a short time ago in what are now deep oceans with comparatively level beds. Existing coral formations do not point to the former existence of great islands. The animals and plants of still existing high lands should be more varied in genera and species if such lands were formerly parts of considerable archipelagos.

THE new technical journal, *Air*, does not appear to be a great innovation, judging from No. 3, which is in our hands. There is, however, in this number, one interesting article by Mr. E. A. Sperry, on "Aerial Navigation over Water," which describes very clearly and simply the methods which are in use for measuring the wind-drift of an aeroplane moving over the earth, and the various ways in which the pilot can obtain information as to his actual direction of flight relative to the earth. The construction and use of the drift indicator are explained; and the way in which the direction and velocity of motion of wave crests, and their distance from crest to crest, can be used to afford information as to the flight path is clearly dealt with. Another article, on "The Fundamental Equations of an Aeroplane," succeeds, after three pages of involved argument, in arriving at a simple aerodynamic conclusion which could be stated in as many lines. The reasoning reads as if the main object had been to make an exceedingly simple argument look as complicated as possible.

THE youthful Society of Glass Technology has begun its career with every indication of a vigorous and useful future. At the meeting on January 18, held at Leeds, two papers were read on the subject of British glass sands. The first, by Dr. P. G. H. Boswell, on "British Sands: their Location and Characteristics," dealt with the chemical, mechanical, and mineral analysis of sands. The author stated that the analysis of British sands had proved their value. The proof of the pudding, however, is in the eating, and Mr. C. J. Peddle, in the second paper, "British Glass Sands: the Substitution of Foreign Sands by British Sands for High-grade Glass-making," demonstrated by actual melts made from native sands what could be done with the material. A good glass sand should attain the requisite degree of purity; it should be evenly graded, and the grains should be angular; consignments should not vary in character and should be ready for use when they reach the manufacturer. The author pointed out that all these essentials are fulfilled by Fontainebleau sand, but not all by British sand as at present supplied. That some British sands compare favourably with those of Fontainebleau as regards purity and grading has been established by the author, whose results in general were in agreement with those of Dr. Boswell. Much depends upon the treatment of the sand for the market. Excellent results were obtainable with properly prepared British sands, as was shown by the samples of glasses made from them, some of which could not be distinguished from similar melts made from Fontainebleau sand. The question of transport charges is one which closely affects the home sand industry; in the past, on account of through rates for carriage, foreign sands have frequently been delivered at the works at a lower cost than it was possible to supply the British material.

WE have received from the Cambridge Scientific Instrument Co., Ltd., a new list of their resistance pyrometers for indicating or recording temperatures from -200° to 1200° C. They all depend on the platinum thermometer, of which four types suitable for different purposes are figured and described. The temperature is shown either on a Whipple indicator or on a Callendar recorder. A sample chart shows a continuous record of the temperature of a hot blast in an ironworks during twenty-five hours. The information given is sufficient to enable anyone with an elementary knowledge of electricity to set up and understand the working of the instruments.

MESSRS. HENRY HOLT AND CO. (New York) are publishing very shortly new and revised editions of Prof. A. L. Kimball's "College Text-book of Physics" and Prof. Martin's "The Human Body: Advanced Course."

THE new list of announcements of Messrs. John Wiley and Sons, Inc. (New York) (London: Messrs. Chapman and Hall, Ltd.) includes: "The Sun's Radiation and other Solar Phenomena," F. H. Bigelow; "Interior Wiring and Systems for Electric Light and Power Service," A. L. Cook; "Irrigation Works Constructed by the United States Government," A. P. Davis; "Bio-Chemical Catalysts," J. Effront (being vol. ii. of "Enzymes and their Applications"), translated by Prof. S. C. Prescott; "Microscopic Examination of Steel," Prof. H. Fay; "Fats and Fatty Degeneration," Prof. M. H. Fischer and Dr. M. O. Hooper; "Agricultural Chemistry," Prof. T. E. Keitt; "The Essentials of American Timber Law," J. P. Kinney; "Elements of Hydrology," Prof. A. F. Meyer; "A German-English Dictionary for Chemists," Dr. A. M. Patterson; "Mechanical Equipment of Buildings"—part ii., "Power Plants and Refrigeration," L. A. Harding and Prof. A. C. Willard; "Printing: A Text-book for Printers, Apprentices, Continuation Classes in Printing, and General Use in Schools and Colleges," F. S. Henry; "The Efficient Purchase and Utilization of Mine Supplies," H. N. Stronck and J. R. Billyard; "Stresses in Structural Steel Angles," Prof. L. A. Waterbury; "Sanitation Practically Applied," H. B. Wood; and "French Forests and Forestry," T. S. Woolsey, jun.

THE classified list of second-hand instruments for sale or hire, just received from Messrs. C. Baker, 244 High Holborn, London, includes particulars of hundreds of microscopes, surveying and drawing instruments, telescopes, spectroscopes, optical lanterns, and other apparatus and accessories. The list is well arranged, and should be of real service to intending purchasers of second-hand optical instruments.

OUR ASTRONOMICAL COLUMN.

DETERMINATION OF STAR COLOURS.—An expeditious photographic method of investigating the colour-indices of stars has been tested by Mr. F. H. Seares at Mt. Wilson (Proc. Nat. Acad. Sci., vol. iii., p. 29). The method consists of making a series of exposures with graduated exposure-times, first through a yellow filter and then without filter. In this way the ratio of exposure-times necessary to give images of the same size in yellow and blue light is determined. The colour-indices are then derived by reference to a curve showing similar ratios for standard polar stars, the colours of which have already been ascertained by a comparison of their photographic and visual magnitudes. In general, the method of exposure-ratios gives excellent results, showing no systematic errors of any importance which depend upon stellar magnitude. The probable error of a colour-index derived from a single exposure-ratio is 0·07 magnitude. The method would appear to be of special value on account of its independence of stellar magnitude, and because it gives a direct measure of the colour. The results obviously include that part of the colour which is a function of the star's intrinsic luminosity, and also such colour effect as may be due to the scattering of light in space. An interesting outcome of the new observations is the confirmation of the previously reported conclusion that there are no faint white stars in the vicinity of the pole, though this is apparently not true of all parts of the sky.

MANCHESTER ASTRONOMICAL SOCIETY.—It is gratifying to note that the activity of the Manchester Astronomical Society has been well maintained. The journal for the session 1915–16 indicates a membership of about 120, and an average attendance at the meetings of forty-seven, while no fewer than eighteen members contributed papers relating to their own observations. A summary of the proceedings is given, and the papers printed at length include "The Colours and Spectra of the Stars," by Father Cortie; "Satellite Systems," by Prof. R. A. Sampson; and "Astronomical Drawings," by W. Porthouse.

CANADIAN OBSERVER'S HANDBOOK.—The Royal Astronomical Society of Canada renders a valuable service to amateur astronomers in the Dominion by the annual issue of "The Observer's Handbook." The volume for 1917 includes the usual astronomical information in a convenient form, and an extensive set of tables by means of which the times of sunrise and sunset in any part of the country can very readily be determined. Another feature calling for special mention is a catalogue giving the chief known facts regarding 276 stars and 13 nebulæ, including proper motion, parallax, spectral type, and radial velocity. There is also a simple guide to the constellations, with maps. The price of the handbook is 25 cents.

EDUCATIONAL REFORM.

MR. H. A. L. FISHER, the new President of the Board of Education, has not wasted much time in submitting his proposals for educational reform to the Cabinet, with a view to immediate legislation. The most urgent and necessary demand is that the compulsory school age for the children of the elementary schools shall be made effective until the age of fourteen at least is reached, and that all exemptions permitting the child to escape from school before that age shall be abolished. One of the greatest impediments in the way of this long-needed reform is to be found in the half-time system which prevails almost entirely in the well-paid textile districts of Lancashire and Yorkshire, to the abolition of which, despite the pleadings of trade-union leaders and of the Workers' Educational Association, the majority of the workers and even some employers are steadily opposed. It is a case where the Government ought to ignore merely political considerations in the best interests of the child and of the nation as a whole, and take a strong lead. Those concerned with this vital reform must either convert their constituents or urge the Government to immediate and drastic action.

The question of the number and efficiency of the male teaching staff of the elementary schools is scarcely less significant and urgent, especially as there would be a very large accession to the number and quality of the pupils if all exemptions were abolished and the compulsory school age raised to fourteen, thereby retaining in the schools the cleverer pupils, who by reason of their ability have hitherto been allowed to leave school at an earlier age than the average scholar. Such children, where they are boys, will need as they approach adolescence more of the experience and control of the trained male teacher, whose numbers, if the schools are to be maintained effectively, must be materially increased.

But to secure such a body of trained and educated men (and the estimated number required is not nearly sufficient, especially if the size of the classes be largely reduced, as it should be), the attractions of the profession, alike in respect of status, salary, prospects, and pension, must be greatly improved. The measures above mentioned will inevitably result in a demand for a better quality of teaching and of education for the scholars, and will react favourably upon the secondary school and its work, inducing a larger number at an earlier age to seek its advantages. These changes will require a much larger expenditure; now is the time to embark upon it, and it is to be hoped that Mr. Fisher, with his wide educational experience and authority, may be able to induce his colleagues to view them with sympathy and Parliament to give them immediate effect.

PRODUCTION OF IRON AND STEEL IN CANADA.

THE Canadian Department of Mines has issued the usual advance chapter of the annual report dealing with the production of iron and steel in the Dominion in 1915, and simultaneously an approximate estimate of the production of iron, steel, and coal in 1916. It appears from these statistics that the output of iron and steel has increased considerably in both years. The total production of pig-iron for 1916 is given as 1,046,185 long tons, as against 815,870 long tons in 1915, and 699,256 long tons in 1914, the pre-war level being thus exceeded. The steel production for 1916 is also the highest on record, namely, 1,270,969 long tons of ingots and 27,356 long tons of direct castings, as against 876,591 long tons of ingots and 27,739 long tons of direct castings in 1915. It is very interesting to note that in 1916 no fewer than 39,098 tons of steel were produced in the electric furnace, as against 61 tons in 1915, so that this new process has made important advances, and appears to have found a permanent footing in Canada. A noteworthy feature of Canadian steel manufacture is the large proportion of old scrap that is worked up, this amounting to about 55 per cent. of the pig-iron charged. The ores used in the manufacture of pig-iron in 1915 were 293,305 short tons of native ore, which, together with 623,094 short tons of Lake Superior ore, imported from the United States, were smelted in the province of Ontario, almost wholly with coke imported also from the United States; practically all the balance of the pig-iron was produced in Nova Scotia from Wabana ore, imported from Newfoundland, the imports amounting to 802,128 short tons.

The coal production of Canada for 1916 is given as 14,365,000 short tons, as against 13,267,023 short tons in 1915. The main increase comes from Alberta, being there about one million tons; British Columbia shows an increase of about half a million tons, and Nova Scotia a decrease of practically the same amount.

THE "SEI" WHALE.[1]

THE profusely illustrated monograph before us is the second of a series, the first of which dealt with the Californian grey whale, *Rhachianectes glaucus*. In the same thorough way that he initiated in describing Rhachianectes Mr. R. S. Andrews now deals with the rorqual, *Balaenoptera borealis*. The result of his work is a much larger volume, which is due, first, to the greater mass of information which has accumulated concerning the better-known *Balaenoptera borealis*, and in the second place to an appendix in which Mr. Schulte publishes the data acquired by the investigation of a young fœtus of this whale. The two sections are approximately equal in length.

The author uses throughout the vernacular name for the whale which is common among the Norwegians, slightly anglicising it from "Sejhval" to "Sei Whale." This, he maintains, and with justice, is less cumbrous than the really pseudo-vernacular term of "Rudolphi's Rorqual," which finds a place in so many English treatises and memoirs. The origin of the Norwegian whalers' name is derived from the fact that this rorqual, formerly at any rate, arrived upon the coast of Finmark in company with the "coalfish," known to the fishermen as "Seje." From this it will be rightly inferred that the fishery of this whale is prominently a Norwegian industry, and Dr. Andrews takes occasion to deal very fully with the late and well-known Norwegian naturalist, Dr. Collett's exhaustive memoir upon this whale in its various aspects, scientific and industrial; this memoir was published some years ago in the Proceedings of the Zoological Society of London. Dr. Andrews himself acquired most of his first-hand knowledge of *Balaenoptera borealis* at the Japanese fisheries, most of which stations he would seem to have visited.

A comparison of the careful work done at these two regions, so far separated from each other, leads Dr. Andrews to the conclusion accepted to-day by, as we imagine, most persons: that this whale, like so many others, has a vast range in space, and that the occurrence of a given whale in areas so remote mutually

1 "Monographs of the Pacific Cetacea." By R. S. Andrews.—II. "The Sei Whale (*Balaenoptera borealis*, Lesson)" Mem. Amer. Mus. Nat. Hist., n.s., vol. i.

as the eastern Atlantic and the western Pacific is by no means evidence of specific distinctness. The list of synonyms of this whale—and indeed of most—is a proof of the existence of an earlier opinion, promulgated by Dr. J. E. Gray and others of his time, that whales were coped within much narrower boundaries than we now think. To the solution of this question Dr. Andrews has added a number of facts; he has dwelt upon the colour variability, which he declares to be "enormous," and not at all influenced by age or sex. He has furthermore made the important observation that parasites taken from whales killed near Japan are at times infested with parasites representing an Antarctic species, which they must have acquired during a soiourn in those southern seas. The parasite in question is the Copepod, *Penella antarctica.*

A short time ago an alleged new species of Ballænoptera admittedly near to *B. borealis,* and named *B. brydei,* was described from the Cape region in a paper published by the Zoological Society. Dr. Andrews carefully considers this whale, and is disinclined to believe in its distinctness, but considers the matter incapable of settlement until more information concerning structure is received; but with this possible exception, and that of *B. edeni,* it would appear that all the alleged species allied to *B. borealis* are to be regarded merely as synonyms. Dr. Schulte's account of the fœtus is full and elaborate. Kükenthal and others have of late years dealt with the adult and fœtus of this and other Balænopteras, and therefore there are not facts of very wide interest left over to be recorded in the memoir. But nevertheless it is valuable, especially for its detailed account of the skull and musculature, which are illustrated by several plates.

F. E. Beddard.

SCIENCE FOR THE PEOPLE.

In this country we are only just beginning to awake to the fact that museums have a great future before them in the task of bringing home to the nation the value and importance of scientific research. In this we are a long way behind the United States, which, through numerous channels, makes strenuous efforts to enlist the interest and sympathy of the public in all that concerns science and its importance as a factor in civilisation and progress. In this the American Museum of Natural History has played, and is playing, a very important part, not only in regard to its exhibition galleries, but also by its efforts to reach those who live outside its radius. By means of the *American Museum Journal,* it gives to the world at large, month by month, a series of lucidly written and skilfully chosen articles by members of its staff and others of established reputation on the various problems which are engaging the attention of specialists.

In the December number, which may be taken as a fair average specimen, nine essays are included, covering a wide range of subjects, thus ensuring an appeal to a large number of readers, as well as an opportunity of arousing dormant interests. Dr. C. Wissler, of the anthropological department, discusses American Indian saddles and the origin and adaptations of horse-culture in the New World, while Dr. W. D. Matthew writes on elephant-ivory and the evolution of the elephant. The Gulf Stream and the effect of ocean currents of different temperatures on the life and range of marine animals, and the phenomena of the mirage, rivet the attention on very different aspects of Nature. The significance of the vivid hues which prevail among tropical fishes introduces the reader to the knotty problems which await solution in regard to animal coloration, while the brief essay on the life-histories of insects opens up yet another vista.

Finally, we may mention the very important article on game protection by Mr. J. B. Burnham, the president of the American Game Protection Association. Herein the author shows the remarkable results which have been obtained by State protection of hen pheasants in New York State, and of the does of the Virginian deer in Vermont. No more convincing vindication of legislation framed for the protection and preservation of native animals from the raids of "sportsmen" was ever penned than this. And there could be no more suitable channel devised for the dissemination of the results of this legislation than this always fascinating journal, which, unfortunately, has no counterpart in this country.

We look forward to the time when the British Museum shall undertake a similar task for Great Britain and our Empire beyond the Seas. The funds, however, for the American journal, it should be remarked, are not provided by the State, but by the generosity of those interested in the welfare of the museum and the furtherance of its work.

W. P. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—The Huxley lecture is to be delivered by Prof. D'Arcy W. Thompson, who has chosen a morphological subject entitled "Shells" for his address.

Cambridge.—The Adams prize has been awarded to Mr. J. H. Jeans, F.R.S., formerly fellow of Trinity, for an essay on "Some Problems of Cosmogony and Stellar Dynamics."

London.—The degree of D.Sc. in chemistry has been conferred on Mr. S. W. Smith, an external student, for a thesis entitled "Surface Tension of Molten Metals and its Relation to other Properties of Metals and Alloys in the Solid State," and other papers.

The report of the Military Education Committee has been presented to the Senate. It states that he number of cadets of the University of London Officers' Training Corps who have obtained commissions up to the end of 1916 was 3010, an increase of about 750 over the corresponding number a year earlier. The distinctions obtained by these officers include: V.C., 2; D.S.O., 3; Military Cross, 131; mentioned in despatches, 151; and represent more than 10 per cent. of those who have seen active service at the Front. In the earlier days of the war 300 graduates and students of the University (not being cadets or ex-cadets of the O.T.C.) obtained commissions on the recommendation of the committee. In consequence of the Military Service Act, the work of the combatant units of the O.T.C. is now restricted to the younger men. The number of individual cadets who were members of the contingent during the training year ending September, 1916, was 2077, of whom 741 remained on the strength at the end of the year. The Medical Unit, in which all medical students permitted to continue their studies are enrolled, is at full strength. The Artillery Unit has been temporarily disbanded. The report refers also to the Officers' School of Instruction in connection with the contingent, through which 1100 young officers have passed; and to the assistance given by the committee in connection with the enlistment of trained chemists in the Royal Engineers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 15.—Sir J. J. Thomson, president, in the chair.—Dr. J. H. **Mummery**: The structure and development of the tubular enamel of the Sparidæ and Labridæ. The author endeavours to show that the enamel of Sparidæ and Labridæ is a true tubular structure. Stains can be made to enter the tubes and traverse their finest branches.—Harriette **Chick** and E. M. M. **Hume**: (1) The distribution in wheat, rice, and maize grains of the substance the deficiency of which in a diet causes polyneuritis in birds and beri-beri in man. (2) The effect of exposure to temperature at or above 100° C. upon the substance (vitamine) the deficiency of which in a diet causes polyneuritis in birds and beri-beri in man.

Linnean Society, February 1.—Sir David Prain, president, in the chair.—C. E. **Salmon**: Some plants that might occur in Britain. Some undoubtedly native species would seem unlikely from their European distribution to occur here, such as *Sagina reuteri*, Boiss., and *Lloydia alpina*, Salisb., whilst it is manifestly uncertain what species may be ultimately found in Britain. Ten species were chosen, all well-defined plants, and recognised on the Continent, leaving out consideration of microspecies for the present.—Prof. W. A. **Herdman**: An account of a paper by Prof. W. J. **Dakin** on his exploration of the Houtman Abrolhos Islands, especially describing the formation of these coral islands. The paper is introductory to accounts of the fauna and flora. The group of islands extends between 28° 15′ and 29° S. lat., the archipelago being about fifty miles long, all four groups of islets running approximately N.N.W.-S.S.E.; they are only about six feet above sea-level, and practically destitute of water, the largest plants being mangroves on the lagoon flats. A few guano workers are the sole inhabitants.—J. **Charlesworth** and J. **Ramsbottom**: The structure of the leaves of hybrid orchids. An investigation of the anatomical characters of the leaves of the parents and their hybrids shows that a structure, when present in both parents in different amounts, appears in the hybrid intermediate in every way. This can be well seen by observing the microscopic characters of hybrids which have one parent in common; *Cochlioda noezliana* occurs as the female parent in six of the primary hybrids investigated and in the two secondary. When a character is present in one of the parents it may or may not be found in the hybrid. In general, if the character of one parent does occur in the hybrid, it is much less developed than in the parent. Sections of the leaves of thirteen primary hybrids and their parents were exhibited.

Zoological Society, February 6.—Prof. E. W. MacBride, vice-president, in the chair.—L. A. **Borradaile**: The structure and function of the mouth-parts of the Palæmonid prawns. The primitive crustacean limb is regarded as consisting of a flattened axis with a flabellum (exopodite), two or more epipodites, a series of eight endites, and an apical lobe, the flabellum standing opposite the third and fourth endites. The relation of the several jaws to this prototype was discussed. The latter part of the paper gives an account of observations upon the use of the mouth-parts during feeding; the second maxillipeds, maxillules, and mandibles were found to play more important parts than the first maxillipeds and the maxillæ.—Prof. H. G. **Plimmer**: Report on the deaths which occurred in the society's gardens during 1916, and on the blood-parasites found during the same period.

Royal Meteorological Society, February 21.—Major H. G. Lyons, president, in the chair.—W. H. **Dines**: Heat balance of the atmosphere. The paper traces the history of the solar radiation from the time it reaches the outer limit of the atmosphere until it is radiated back into space, assigning from the data available limits to the amounts absorbed, transmitted, and reflected by the air, and to the amounts mutually radiated between the earth, the air, and outer space. A note is added showing that a "grey" body in the position of the upper air should have a temperature of about 300° A.—C. E. P. **Brooks**: Continentality and temperature. The distribution of temperature over the surface of the earth is complex, being related to various factors—latitude, height, distance from the sea, etc. Further, since even smoothed isotherms reduced to sea-level often show very little relation to lines of latitude, it is evident that in some cases geographical conditions must exercise a predominant effect. This effect was investigated in the case of the distribution of temperature over Europe and western Asia during January and July. Fifty-six representative stations were selected, and by the method of partial correlation regression equations were constructed showing how the temperature of any place in the area may be built up from its height, its latitude, and the percentage of land in the area surrounding it. The function taken to represent latitude was the quantity of heat which would be received on a horizontal surface with a transmission coefficient of 0·7, on the shortest day and the longest day respectively (the last proviso allowed a lag of about three weeks in the thermal effect of the sun's radiation). That this gives a good measure of heat received is shown by the correlation coefficient of +0·944 found between it and the temperature in January. From these regression equations the temperatures of the original stations were calculated, and over a range of 50° F. in January the average error was found to be about 1°; in July the error was much less. Finally, the equations were applied to the altered geography of the early Neolithic period, and it was found that this entirely accounted for the altered climate of that period, and the various astronomical theories which have been brought in to explain it are quite unnecessary.

EDINBURGH.

Royal Society, January 22.—Dr. Horne, president, in the chair.—Lieut. C. K. M. **Douglas**: Some causes of the formation of anticyclonic stratus as observed from aeroplanes. This discussion of the problem of why the weather in anticyclonic distributions is frequently cloudy was suggested by observations made while flying in France. These stratus-clouds are of meteorological importance, preventing the development of severe frost. The tops of the clouds are usually 4000 or 5000 ft. above sea-level, and above them there is a well-marked rise of temperature, sometimes nearly 10° F. in 500 ft. This temperature increase was usually found associated with an increase of the westerly component of the wind. Along the lower margin of this western wind the stratus formed.—W. **Ritchie**: The structure, bionomics, and forest importance of *Myelophilus minor*. This destructive enemy of Scotch pine, formerly believed to be rare, exists in thousands at the tops of the trees. The damage done is of two kinds: first, by the adult boring into the young shoots and destroying them in hundreds; secondly, by the larvæ working below the bark and interfering with the passage of sap. The differences between this species and *M. pimperda* were pointed out, and new evidence was obtained of the life of the adult being extended over more generations than one.

BOOKS RECEIVED.

The Vaporizing of Paraffin for High-Speed Motors (Electric Ignition Type). By E. Butler. Pp. vi+120. (London: C. Griffin and Co., Ltd.) 3s. 6d. net.

A Text-Book of Histology. By Dr. H. E. Jordan and Dr. J. S. Ferguson. Pp. xxviii+799. (London and New York: D. Appleton and Co.) 15s. net.

Horses. By R. Pocock. With an Introduction by Prof. J. Cossar Ewart. Pp. x+252. (London: John Murray.) 5s. net.

The Land and the Empire. By C. Turnor. Pp. 144. (London: John Murray.) 3s. 6d. net.

Comptes Rendus of Observation and Reasoning. By J. Y. Buchanan. Pp. xl+452. (Cambridge: At the University Press.) 7s. 6d. net.

Explosives. By A. Marshall. Second edition. Two vols. Vol. i., pp. xv+407. (London: J. and A. Churchill.) 3l. 3s. net the two vols.

Laboratory Manual of General Chemistry, with Exercises in the Preparation of Inorganic Substances. By A. B. Lamb. Pp. vi+166. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 6s. net.

German and English Education: a Comparative Study. By Dr. Fr. De Hovre. Pp. 108. (London: Constable and Co., Ltd.) 2s. 6d. net.

The Permanent Values in Education. By K. Richmond. Pp. xxiii+136. (London: Constable and Co., Ltd.) 2s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—A Graphical Method of Drawing Trajectories for High-Angle Fire: Prof. W. E. Dalby.—Osmotic Pressures Derived from Vapour-Pressure Measurements; Aqueous Solutions of Cane Sugar and Methyl Glucoside: The Earl of Berkeley E. G. J. Hartley, and C. V. Burton.—The Complete Photo-Electric Emission from the Alloy of Sodium and Potassium: W. Wilson.

ROYAL INSTITUTION, at 3.—Memorial Art To-day: Prof. E. S. Prior.

MATHEMATICAL SOCIETY, at 5.30.

CHEMICAL SOCIETY, at 8.—Notes on the Effect of Heat and Oxidation on Linseed Oil: J. A. N. Friend.—Acyl Derivatives of Paradiazoiminobenzene: G. T. Morgan and A. W. H. Upton.

LINNEAN SOCIETY, at 5.—Some Observations on the Feeding Habits of Fish and Birds, with Special Reference to Warning Coloration: J. C. Mottram.—The Heterangiums of the British Coal Measures: Dr. D. H. Scott.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 5.30.—Cellulose and Chemical Industry (1866–1916): C. F. Cross.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Pronunciation of English at the Time of Shakespeare. (Lecture II.): Daniel Jones.

MONDAY, MARCH 5.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Indian Frontier Geography: Col. Sir Francis Younghusband.

ARISTOTELIAN SOCIETY, at 8.—Fact and Truth: Prof. C. Lloyd Morgan.

ROYAL SOCIETY OF ARTS, at 4.30.—Memorials and Monuments: Lawrence Weaver.

SOCIETY OF ENGINEERS, at 5.30.—High Tensile Steel *versus* Mild Steel for Reinforced Concrete: A. W. C. Shelf.

VICTORIA INSTITUTE, at 4.30.—The Conscience: Clement C. L. Webb.

TUESDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Internal Combustion Engines: Prof. W. E. Dalby.

ZOOLOGICAL SOCIETY, at 5.30.—Work of the Beavers in the Society's Gardens: R. I. Pocock.—The Scolex in the Cestode Genus Duthiersia, and the Species of that Genus: Dr. F. E. Beddard.—An Experimental Investigation of the Migration of Woodcock Breeding in the West of Ireland: Capt. S. R. Douglas.

RÖNTGEN SOCIETY, at 8.15.

FARADAY SOCIETY, at 8.—*General Discussion:* The Training and Work of the Chemical Engineer: Opener, Sir George Beilby.—The Training of the Medical Student for Work in the Factory: Prof. F. G. Donnan.—The Training of the Works Chemist in Physics: C. R. Darling.—A Plea for the Forgotten Factor in Chemical Training: W. R. Cooper.—The Work of the Imperial College in the Training of Chemical Engineers: J. W. Hinchley.

WEDNESDAY, MARCH 7.

ROYAL SOCIETY OF ARTS, at 4.30.—German Business Methods: J. H. Vickery.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Quantitative Estimation of Mercury in Organic Compounds: J. E. Marsh and O. G. Lye.—The Composition of Milk: P. S. Arup, H. C. Huish, and H. Droop Richmond.—(1) Studies in Steam Distillation: Part 4, Propionic, Butyric, Valeric, and Caproic Acids. (2) Studies in Steam Distillation: Part 5, The Analysis of Acetic Anhydride and Alkyl-Malonic Acids: H. Droop Richmond.—Note on Salvarsan and Neo-Salvarsan: J. Webster.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Some Effects of Growth-promoting Substances (Auximones) on the Growth of *Lemna minor* in Culture Solutions: W. B. Bottomley.—Some Effects of Growth-promoting Substances (Auximones) on the Soil Organisms concerned in the Nitrogen Cycle: Florence A. Mockeridge.

ROYAL INSTITUTION, at 3.—Sponges; a Study in Evolutionary Biology: Prof. A. Dendy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Voltage Regulation of Rotary Converters: G. A. Juhlin.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 5.30.—The Treatment of Wounds in War: Sir Almroth Wright.

MALACOLOGICAL SOCIETY, at 7.—The Genitalia of *Neanthinula aculeata:* Dr. A. E. Boycott.—(1) The Radula of the Genus Cominella; (2) A Colony of *Purpura lapillus*, with Operculum Malformed or Absent; (3) Note on the Adventures of the Genus named Lucena; (4) Note on the Da Costa Plates adapted for Rackett's Edition of Pulteney's Catalogues: B. B. Woodward.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Imperial Eugenics; Saving the Soldier: Dr. C. W. Saleeby.

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THURSDAY, MARCH 8, 1917.

MENTAL ORGANISATION.

Organic to Human: Psychological and Sociological. By Dr. Henry Maudsley. Pp. viii + 386. (London: Macmillan and Co., Ltd., 1916.) Price 12s. net.

WE welcome this vigorous expression of a distinguished veteran's convictions in regard to some of the major problems of evolution, both organic and social. Mature reflection does not seem to have made Dr. Maudsley more tolerant of metaphysicians, men of feeling, and others of that clan; he remains, in fact, a consistent unbending type of those whom William James called "tough-minded," and he writes as trenchantly as ever about the folly of man's overweening intellectual conceit. One of the central ideas of his book is that of the unity of the organism, which discharges mental as well as motor functions by a nervous organisation in which every part co-operates.

"The whole body enters into the constitution of every mood, thought, and feeling." The author sees man as solidary with the rest of creation on his mental as well as on his bodily side. We are glad to see that he recognises that "there is obviously plenty of seemingly conscious work in animal nature outside human nature, though not, of course, so complexly reflective intra-mentally." With these conclusions many biologists will agree, but few will now follow Dr. Maudsley in his Lamarckian explanation of man's cerebral organisation as "embodying the cumulative acquisitions of immemorial adaptive experience from age to age."

Dr. Maudsley makes much of "mental organisation," which might well have been the title of his book had not the word been vulgarised in other connections. The idea is a sound one that individual initiatives may somehow become enregistered in the hereditary constitution of the race. The author also uses the vivid phrase "mental capitalisation" for the way in which man secures external registration—in implement and machine, in cultivated plant and written word—of the gains of ages. "The wonderful calculation it would be to estimate the number of mind-powers incorporate in and now represented by the modern battleship evolved step by step from the primitive canoe. . . . It is in like manner that the intelligent instincts of animals represent the silent memories of past habits, of acquired function grafted in structure, and that the innate capacities and aptitudes of human intellect signify the quintessence of immemorial consolidate adaptations transmitted as unconscious mind by heredity." But this is very questionable interpretation. That there is "mental capitalisation" in battleship and brain alike seems indubitable; but the resemblance in process in the two cases is purely formal. That the brain of any organism grew rich in the course of evolution by accumulating the acquisitions of individual thrift is a very hazardous biological hypothesis. Facts are wanted!

We are precluded by limits of space from any appreciation of Dr. Maudsley's stimulating and critical discussions concerning the relation of science to social advance, the conditions of civilisation, the microbe and man, social evolution, and the moralisation of the reproductive instinct; we must pass on to the last chapter, where the view is expounded that "materialism neither can nor ought to be got rid of. To think such riddance possible is to perpetuate pretence and invite unrealities and hypocrisies of thought."

For a man of his experience Dr. Maudsley is surprising in the convincedness with which he continually suggests that all the hard, resolute, sincere, critical thinking is done by tough-minded scientific analysts. This conviction is more grotesque than the "ungainly, contorted, or otherwise ungraceful bodies" which Dr. Maudsley has discovered in the animal kingdom. It is equally fictitious. Another psychologically erroneous view, as it seems to us, is expressed in the copious cold water which the book pours on those who cannot settle down sensibly and give up the adventure of trying to interpret Nature. As if that were not the very last thing man should give up! A German biologist of distinction wrote not long ago:—"So until the opposite can be proved we must accept the proposition that also human intelligence comprises no psychical factor, and that it has arisen phylogenetically through continual transformation and refinement of physico-chemical nerve-processes." If this sort of position is included in the materialism which Dr. Maudsley does not wish to get rid of, we protest, for it seems to us a false simplicity and bad science. That the position cited would be accepted by Dr. Maudsley we do not suggest, for we understand the author of "The Physiology of Mind" to recognise the reality of psychical factors while contending that they are inseparably bound up with physiological factors in the unified life of the creature. But he sails very near the wind when he says: "Consciousness is not itself a power of doing work." For who cares for ideas if they have not hands and feet?

J. A. T.

BOOKS ON ANALYTICAL CHEMISTRY.

(1) *Analytical Chemistry.* Based on the German text of Prof. F. P. Treadwell. Translated and revised by W. T. Hall. Vol. i., *Qualitative Analysis.* Pp. xiii + 538. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 12s. 6d. net.

(2) *A Method for the Identification of Pure Organic Compounds.* By Prof. S. P. Mulliken. Vol. ii. Pp. ix + 327. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 21s. net.

(1) THE present volume is the fourth English edition of this well-known analytical chemistry, which was first published at Zürich in German in 1899 by the American chemist, F. P.

Treadwell. According to the translator, W. T. Hall, the original has been so thoroughly revised and so largely rewritten that it is no longer fair to publish the book as a literal translation, and though the general plan has been kept, greater stress has been laid upon the theoretical side of the subject. The introductory chapter deals with such general principles as are usually included in text-books on physical chemistry, viz. electrolytic dissociation, electromotive series, solubility product, mass law, etc., subjects which not only come well within the scope, but are essential to the thorough grasp, of analytical methods.

The book is, in short, not the ordinary type of examination *vade mecum*. It is rather in the nature of a philosophical treatise on analysis in which the subject is treated with the thoroughness demanded by a highly important and dignified branch of chemical science. A special feature of the new edition is the use of ionic equations, which often appear side by side with the more usual form. In this way the student is, without much effort, familiarised with both methods of representing reactions.

(2) The procedure adopted by Dr. Mulliken for the identification of pure organic compounds (in vol. ii.) by means of tables follows very closely that of vol. i. Vol. ii. contains what are termed compounds of Order II., which includes those of the three elements, carbon, hydrogen, and oxygen, of vol. i., with the additional element, nitrogen.

The tables are divided into suborders of colourless and coloured compounds, these again into genera comprising acidic, basic, and neutral compounds, and these again into divisions A and B of solid and liquid species.

An illustrative example of the application of the tables is given, and the author claims that the method of identification is much more rapid than that which would have been required to arrive at an equally certain result by the use of the method of empirical formulæ. This may be true of a substance with no previous history which is thrust into the hands of a chemist for rapid identification. But the writer is by no means convinced that, however valuable the data, the arrangement for research purposes is the most satisfactory that could be devised.

Although it may be true that the scheme of species, genera, suborders, and orders may help one, like a botanical key, to track down an unknown compound more quickly than by means of a combustion, one has to remember that it is rarely that a chemist engaged on research is entirely ignorant of the possible nature of the substance he has obtained. It is not a question of one of a possible 4000 compounds described in these tables, but more probably one of half a dozen.

The molecular formulæ and Richter's lexicon will soon put the chemist on the track of a reference; and if, in addition, he has tables of specific reactions arranged according to molecular formulæ, he will rapidly orient his compound, provided it has been described before.

The present arrangement is too mechanical, and makes too little appeal to the previous sequence of chemical events to be entirely satisfactory. At the same time one would not wish to depreciate the value or trustworthiness of the vast and varied data which Dr. Mulliken has compiled with so much care and discrimination. There are distinct, if restricted, uses for such tables.

It may be added in conclusion that not the least important section in the book is chap. iii., giving a list of reagents, their preparation and uses, which many organic chemists often overlook.

J. B. C.

GARDEN AND FIELD.

(1) *The Standard Cyclopaedia of Horticulture.* By L. H. Bailey. Vol. iii., F—K. Pp. v+1201–1760. Vol. iv., L—O. Pp. v.+1761–2421. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915–16.) Price 25*s*. net each vol.

(2) *The Small Grains.* By M. A. Carleton. Pp. xxxii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 7*s*. 6*d*. net.

(1) HORTICULTURE has been well served by its encyclopædists. In this country we possess Nicholson's Dictionary and "The Gardener's Assistant," both admirable works of their kind. But unfortunately, and in spite of the ever-increasing popularity of gardening, no new edition of either of these works has appeared in recent years. One, we know, is under revision, and but for the war a new edition would have appeared before now. No less admirable than these indigenous productions is Bailey's "Standard Cyclopædia of Horticulture," now appearing in a greatly enlarged form. This "cyclopædia" is indispensable to horticulturists if only for the fact that it contains descriptions of the many new garden plants which are of recent introduction, particularly from China. Although this country led the way in the systematic horticultural exploration of that wonderful country, America has made notable contributions thereto, and the many introductions due to Wilson, Forrest, Purdom, Ward, and Farrer are now coming into general cultivation both in the States and here. Not a few of these acquisitions are described in the pages of Dr. Bailey's work.

As is to be expected from the provenance of this work, the sections treating of tools and machinery are particularly well done, the article on machinery and implements extending over upwards of twenty closely printed pages, and beginning with the just claim that "the American is known by his tools and machinery."

Of great interest to British horticulturists also is the comprehensive account given of horticulture in the North American States, to which more than 100 pages of vol. iv. are devoted. The

exporting British horticulturists—and we are too apt to ignore that there is a large horticultural export trade from this country to the States—will derive much valuable information from a study of this section of the work. We commend the account given of the horticultural experiment stations in the various States to the particular attention of those whose business it is to give State encouragement to horticultural research in this country.

The "Cyclopædia" is well and copiously illustrated; the black-and-white figures are excellent. The coloured plates, however, are, as is so often the case, of unequal merit.

Taken as a whole, this American encyclopædia is a great monument to Dr. Bailey's energy and knowledge, and should find its place on the shelves and in the hands of all British gardeners.

(2) In "Small Grains," by Prof. Mark A. Carleton, a comprehensive account is given of the cereal crops—wheat, oats, rye, and barley—and of buckwheat and rice. A mass of useful information is contained in the 700 pages which constitute the book, and it is no doubt useful to the student of "agronomy" to have access to this information within the covers of one book. Nevertheless, it seems to us that a student who mastered the multifarious contents of this volume would do so at the risk of ruin to his mental digestion. In any case, he would deserve the encomium lavished by Goldsmith on the village schoolmaster:—

> . . . and still the wonder grew
> That one small head could carry all he knew.

The English student, at all events, must look on this book rather as a compendious work of reference than as a text-book, and used in this way it will no doubt prove of considerable value.

Particularly good is the account of the different kinds of wheat—common, club wheat, poulard or rivet, durum, einkorn, emmer, spelt, and Polish, and of the chief varieties grown in America and other parts of the world.

With so vast a subject it is not to be wondered at that the discussion of many of its aspects is brief; but to an English reader it appears strange that the author has not found room for the inclusion of Biffen's work on breeding (for although reference is made to that author's determination of dominant characters, nothing is said of his classical experiments in the combination of characters). Nor, though considerable attention is devoted to manuring, do we find, so far as we have been able to discover, any account of the pioneer and fundamental work of Rothamsted.

Although Prof. Carleton's work is designed primarily for the American agronomist, it is one which the scientific agriculturists of this country will be glad to have if only for the somewhat remarkable manner in which the author contrives to give a bird's-eye view of the vast area and diverse conditions over and under which the "small grains" are cultivated in the United States.

OUR BOOKSHELF.

Fatigue Study: The Elimination of Humanity's Greatest Unnecessary Waste: A First Step in Motion Study. By Frank B. Gilbreth and Dr. Lillian M. Gilbreth. Pp. 159. (London: George Routledge and Sons, Ltd., 1916.) Price 6s. net.

THE main thesis of the authors of this book is that much of the fatigue occurring among industrial workers is unnecessary, and is caused by the carrying out of the work under conditions which involve excessive and avoidable expenditure of energy. The methods suggested for the elimination of unnecessary fatigue consist for the most part of various mechanical devices. One of these consists in the provision of high chairs so that the workers can sit to their work instead of having to stand. Another suggestion is the use of chairs provided with springs which exclude vibration from the floors of buildings in which high-speed machinery is used. Considerable attention is directed to the value of organisation in the placing of his material in the most convenient position for handling by the worker, to the importance of suitable lighting, and to the desirability of frequent rest intervals during the day's work. A useful point which is brought out is that the value of rest periods is greatly enhanced by the provision of an adequate supply of rest chairs. The authors find that the application of these methods produces a striking improvement, both in the physical condition of the workers and in the efficiency of their work.

Farm Spies: How the Boys Investigated Field Crop Insects. By Prof. A. F. Conradi and W. A. Thomas. Pp. xi+165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 3s. net.

THIS is a collection of brightly written, well-illustrated "story-articles" on various common injurious insects of North America, designed to catch the attention and enlist the sympathies of "boys and girls and those persons who know nothing about insects and how to fight them." Among the pests described are the cotton boll-weevil and root-louse, chinch-bugs (an American "bug" that is really a bug), grasshoppers, and the black corn weevil. The life-histories and habits of the insects are drawn out by conversations between farmers and entomologists, and the farmers' boys are naturally enlisted in the work of destroying the ravagers of crops. Points in the breeding and feeding habits that bear on farm practice are often cleverly emphasised, and some of our British students might be well occupied in compiling for the Home Country a somewhat similar work. "Nearly every incident mentioned has at some time or other come within the experience of the authors," we are told in the preface. The qualification is satisfying when we read how "Dr. Science, walking across a field, heard a vetch plant and a bacterium talking together," how he asked "Would it be possible for you two to get together and trade?" and how the vetch

suggested: "The bacterium can live on my roots and supply me with nitrogen, and I furnish him with phosphoric acid and potash." Happily such passages, which are neither good science nor good fiction, are rare in the handy little volume.

G. H. C.

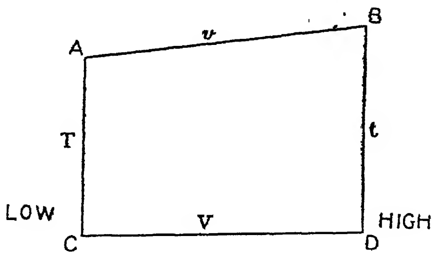
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Horizontal Temperature Gradient and the Increase of Wind with Height.

IT has been known for some time past that from heights of about 1 to 9 km. the temperature is higher in the high-pressure than in the low-pressure area, and also that in general the wind, and especially the west wind, increases with height. The following simple proof shows that these two observational facts are not independent of each other, but that, one being given, the other follows as a logical consequence.

A wind in the northern hemisphere exerts an acceleration towards its right-hand side equal to $2\omega v \sin\phi$, where ω is the earth's rotational velocity, v the velocity of the wind, and ϕ the latitude. Also, if the path of the air particles is curved, there is a further acceleration equal to v^2/r, where r is the radius



of curvature, and the acceleration is away from the centre of curvature. The total acceleration to the right is $2\omega v \sin\phi \pm v^2/r$, and the sign of the term involving v^2 is positive in regions where the isobars are concave to the low pressure. However, in these latitudes the v^2 term is not as a rule important, but appears as a correction, generally positive, to the term $2\omega v \sin\phi$.

Let ABCD be a vertical section at right angles to the gradient wind, AB and CD being sections of the isobaric surfaces, and AC and BD vertical straight lines. If v be the gradient wind—*i.e.* the wind at right angles to the paper—then the tangent of the slope of AB is $2\omega v \sin\phi + v^2/r : g$, for $2\omega v \sin\phi + v^2/r$ is the horizontal acceleration and g the vertical. Similarly, the slope of CD is $2\omega V \sin\phi + V^2/r : g$. If, then, v is greater than V, BD must be greater than AC. Now the pressure difference between A and C is equal to the pressure difference between B and D, since AB and CD are isobaric lines; and since the corresponding elements in the two air columns AC and BD are of equal pressure, and the density in BD less, the temperature in BD must be higher than that in AC. That is, if v be greater than V, then t is greater than T.

Thus where the wind is increasing with height without much change in direction, anyone with his back to the wind will, if he follows an isobaric surface from left to right—that is, from cyclone to anticyclone—find an increasing temperature.

If we neglect the curvature it is easy to calculate the numerical values. An increase of 1 metre per second over a horizontal range of 100 km. in latitude 53° makes BD−AC=1·28 m.; therefore, taking AC as 1 km. and CD as 100 km., an increase of 1 m./s. per km. height makes $t - T = 0{\cdot}00128t$, or, giving to t a mean value of 250*a*, $t - T = 0{\cdot}32°$. Thus an increase of 1 m./s. per km. gives in these latitudes an approximate rise of 1° C. per 300 km. along an isobaric line at right angles to the wind. This is fully in accordance with such observations as are available.

As a corollary it follows that the strongest winds have a high temperature on their right-hand side below their own level and a low temperature above, while on their left the converse holds, and it is cold above and warm below, cold and warm being used relatively to the mean for the height. Since the strongest winds are found near the upper limit of the troposphere in regions where the barometric surface gradient is steep, this again agrees with the usual distribution of temperature in cyclones and anticyclones.

The special tendency of west winds rather than east to increase with height agrees with the natural rise of temperature in the lower strata from north to south.

W. H. DINES.

Benson, February 23.

Ten Per Cent. Agar-agar Jelly.

IT may be of use to put on record a method of making a jelly containing ten or more parts by weight of agar-agar to 100 parts by volume of solvent.

Agar-agar powder is apt to form lumps when mixed with water or with a mixture of water and glycerine. If this difficulty is obviated by vigorous stirring bubbles are formed. In the case of jellies of $1\frac{1}{2}$ or 2 per cent. strength this does not matter, as the bubbles readily come to the surface. With thicker jellies this is not the case. These difficulties are avoided by the following procedure.

Powdered agar-agar is washed with ether, dried, and passed through a sieve. This treatment removes a fatty acid.

Twenty grams of the purified agar-agar are placed in a round-bottomed flask. The flask is provided with a cork having two holes. Through one of the holes passes a tube leading to a vacuum pump. The other tube accommodates the stem of a separating funnel. The air is exhausted, 140 c.c. of glycerine are placed in the funnel and rapidly run into the flask. The flask is shaken for a few seconds, by which time the agar-agar powder will be found to be completely and uniformly suspended in the glycerine. Sixty c.c. of water that has previously been boiled and completely cooled are now placed in the funnel, run into the flask, and mixed with its contents by a few seconds' shaking. Air is allowed to enter the flask, and the mixture is at once run out into a series of glass syringes from which the pistons have been removed and the nozzles of which are closed with rubber caps. Each syringe is filled about two-thirds full of the mixture, the pistons are replaced, and the syringes are then heated in a water-bath. The jelly is now ready for use. Caps for the nozzles may be made by boring a hole nearly, but not quite, through a rubber cork. A bent strip of tin is required for each syringe to hold the cap in place. The jelly when melted is too stiff to pour out of a test-tube. It can be readily squirted from the nozzle of the syringe.

If the proportion of glycerine is increased the jelly is weaker, but more transparent. With less glycerine

and more water the jelly sets more firmly and cuts more easily, but is less transparent.

I have used such jelly in preparing sections of the wings of insects. The wing was first placed in an ordinary silvering solution containing Rochelle salts to which 50 per cent. of alcohol had been added. After it had thereby become blackened from the deposit of metallic silver it was washed with 50 per cent. alcohol and then placed in rectified spirit. To embed the wing after this treatment I formed a cell of plasticine on a sheet of glass. A layer of melted jelly was placed in the cell, which was then filled up with alcohol. The wing was placed in the cell. It dropped through the alcohol on to the surface of the jelly. The alcohol was at once run off by making a cut through the walls of the cell. The latter was then filled up with more of the jelly. By this procedure wings of moths and butterflies, which are not readily wetted by water, could be obtained firmly embedded, free of air-bubbles and without displacement of the scales. To the 60 c.c. of water used in making the jelly I had added 16 grams of hyposulphite of soda. Having cut the lump of jelly containing the wing into ten slices of equal thickness with a Gillette razor-blade, these slices were threaded in order on a wire, and placed all night in a half-saturated solution of tartaric acid in 70 per cent. glycerine. The acid decomposed the hypo., liberating sulphur, with the result that the jelly acquired an ivory-white colour, on which the wing-sections appeared in black. The slices were mounted in a cell containing glycerine jelly. Embedding in celluloid no doubt would be preferable for wings of smaller insects. The method here described is probably more suitable for larger insects, the wings of which would be likely to offer difficulties in an attempt to cut thin sections.

E. H. HANKIN.

Agra, India.

National Service.

THE wording of the enrolment form for National Service having given many the impression that volunteers are wanted only for industrial work, which some men over fifty cannot possibly undertake, I wrote to the Director of National Service for definite information, and my queries were answered as follows:—

"National volunteers are required not only for industrial work, but also for other positions of national importance."

Further: "Mr. Chamberlain wishes it to be clearly understood that brains as well as 'hands' are required, and also that no volunteer will be set to do work for which he is not fitted personally."

These very clear and authoritative replies will, perhaps, relieve the doubts of many who have been hesitating on the very reasonable ground that the work involved seemed to be beyond their capacity.

C. WELBORNE PIPER.

THE CLASSIFICATION OF HELIUM STARS.

WHILE it is now generally admitted that the spectroscopic differences between the different classes of stars are mainly due to differences of temperature, there are two widely divergent views as to the order of celestial evolution which may be inferred. In one of them, the evolution is supposed to proceed by a continuous decline of temperature from the white to the red stars; in the other, which has been consistently advocated by Sir Norman Lockyer during nearly thirty years, it is maintained that the progression is from stars at a low stage of temperature to the hottest stars, and from these to stars at a low temperature, so that a given star will have the same temperature twice in the course of its evolution. The classifications of Rutherfurd, Secchi, and Vogel, and the expansion of these into the Harvard system, may be interpreted in terms of the first hypothesis, though actually they may be regarded as merely empirical and independent of any such consideration. The classification of Lockyer, on the other hand, is essentially based upon the supposition that there must be stars which are getting hotter as well as stars which are cooling, in accordance with the theory of condensing masses of gas or swarms of meteorites.

If the spectrum of a star depended solely upon the surface temperature, there would evidently be no observational means of distinguishing between the two hypotheses. But Lockyer finds that when stars at any given stage of temperature are brought together by reference to the relative intensities of certain lines, selected according to the indications of laboratory experiments, they are divisible into two distinct groups. The spectra, therefore, seem to depend in part upon physical conditions other than those imposed by temperature alone. The difference is quite probably due to a difference in the degree of condensation, and Lockyer's interpretation assigns one of the groups to the ascending, and the other to the descending, branch of the temperature curve. The Harvard classification takes no account of these differences, and is accordingly along one line of temperature only.

The difference between the opposing views as to the order of celestial evolution is clearly of a very fundamental character, and it is important that the question should be attacked in as many ways as possible. The work of Prof. H. N. Russell (NATURE, vol. xciii., p. 283) on the absolute magnitudes of stars has already given considerable support to the main principle of Lockyer's classification, by especially emphasising the idea that the order of celestial evolution is primarily one of increasing density, with a maximum of temperature near the middle of the sequence. As regards the helium stars, Dr. Ludendorff found in 1912 (NATURE, vol. lxxxviii., p. 424) that the radial velocities showed a very decided systematic difference for the ascending and descending stars classified by Lockyer, a difference which was not so clearly shown when the velocities were referred to the Harvard sub-classes.

Since the publication of Ludendorff's results, Lockyer has supplemented his original catalogue of 470 stars by a second catalogue of 354 stars, and a third catalogue of 287 stars, photographed and classified at the Hill Observatory, Sidmouth (*Hill Obs. Bull.*, Nos. 3 and 5). The first attempt to utilise some of the additional data which have thus become available has been made by Dr. B. P. Herassimovitch in a recent communication to the Petrograd Academy of Sciences (Bull. Acad. Imp. Sci., 1916, p. 1419). In this paper the helium stars included in the first two cata-

logues of Lockyer are discussed in relation to the radial velocities, so far as they have been determined. For the ascending branch there are 57 such stars in the two catalogues, and for the descending branch 47 stars.

It should perhaps be recalled that the helium stars constitute type B of the Harvard classification, and are subdivided into classes B0 to B9, in accordance with variations in detail. In Lockyer's system, seven classes of helium stars are recognised, three on the ascending branch, one at the apex, and three more on the descending branch of the temperature curve, thus:—

	Alnitamian	
↑ Crucian		Achernian ↓
Taurian		Algolian
Rigelian		Markabian

It was found by Campbell that after eliminating the apparent velocity due to the sun's motion, the helium stars showed a systematic positive (receding) velocity of +4·07 km.; the apex of the sun's way being taken as $\alpha = 270°$, $\delta = +30°$. This systematic error, which was designated "K" by Campbell, has not yet been satisfactorily accounted for, but it is such as would arise if, in the helium stars, the lines were subject to a pressure effect which caused them to be displaced slightly to the red side of their normal positions; the effect of such a displacement would clearly be to superpose on the real radial motions a receding velocity of about 4 km. for all the stars, irrespective of their positions on the celestial sphere. The magnitude of K, and the sun's velocity, are determined on the supposition that, in the mean, the stars are at rest with respect to the stellar system.

Forming the helium stars on the ascending branch of Lockyer's series into one group, and those of the descending branch into another, Dr. Herassimovitch proceeds in the usual way to determine the sun's velocity and the K term for each group, using equations of the form

$$V_0 \cos \phi + K = V,$$

where V_0 is the velocity of the sun, ϕ the angular distance of the star from the apex of the sun's way, V the observed radial velocity reduced to the sun by correction for the earth's orbital motion, and K the residual velocity. In each group, K is thus the mean algebraic residual after eliminating the solar motion. The results are as follows:—

From 57 stars on the ascending branch $\begin{cases} K = +\ 6·32 \text{ km.} \pm 1·50 \text{ km.} \\ V_0 = -20·84 \text{ km.} \pm 2·40 \text{ km.} \end{cases}$

rom 47 stars on the descending branch $\begin{cases} K = +\ 1·17 \text{ km.} \pm 1·136 \text{ km.} \\ V_0 = -20·03 \text{ km.} \pm 2·29 \text{ km.} \end{cases}$

Thus, while the resulting velocity of the sun is almost the same for the two groups, the values of K are strikingly different. For the descending branch, in fact, K almost disappears, while for the ascending branch its value is considerably in excess of that found by Campbell from all the helium stars taken together. Lockyer's differentiation of the ascending and descending branches thus receives substantial corroboration.

It was already known from the work of Campbell that the groups of stars giving the largest values of K (*i.e.* the Harvard classes B, K, and M [1]) are among the most distant, and Dr. Herassimovitch has therefore further discussed the ascending and descending groups in relation to the mean parallaxes. Applying Kapteyn's formulæ, it results that for the helium stars on the ascending branch the probable mean parallax is 0·005″ ± 0·0009″, and for the descending branch 0·012″ ± 0·0030″. By the same process, Campbell has found for the Harvard classes B0–B5 a mean parallax of 0·006″, and for the classes B8–B9 a mean parallax of 0·0129″, which are nearly identical with the values now found for the ascending and descending stars. A predominance of B0–B5 stars on the ascending branch, and of B8–B9 stars on the descending branch, would thus account for the observed difference in the mean parallaxes. But this cannot account for the whole difference, for although there are actually a greater number of B8–B9 stars on the descending than on the ascending branch of Lockyer's curve, the excess among the stars here considered is only four. It would seem, then, as in the general case, that the more distant group of helium stars gives the larger value of the K term, and it is interesting to find that Lockyer's criteria for spectroscopic classification have so successfully withstood this further test.

Dr. Herassimovitch has also investigated the ascending and descending groups in relation to the magnitudes of the stars involved. Omitting those at the summit of the curve, there are 155 helium stars available for this part of the inquiry, and the figures show that the stars on the descending branch are in general fainter than those on the ascending branch. This difference cannot be explained entirely by the excess of classes B8–B9 on the descending branch, because within the limits of a given Harvard sub-group, say B3–B5, there is the same increase in the number of faint stars on the descending branch as when all the B stars are taken together. When correction is made to absolute magnitudes, by applying the mean parallaxes previously deduced, it also appears that the stars of the descending branch are in general fainter than those of the ascending branch which fall in the same Harvard sub-class, and are therefore presumably at the same stage of temperature.

Stars at the same heat level on opposite sides of the temperature curve probably have the same intrinsic brightness, and if it be assumed that the average masses are equal, it would follow that the stars on the ascending branch must in general be of greater volume and lower density than those on the descending branch. This is precisely the physical difference which is demanded by Lockyer's hypothesis, and also by that of Russell, and it may reasonably be supposed capable of explaining the spectroscopic differences which have enabled Lockyer to sort out the two classes.

The nature of the K term remains obscure. If the greater brightness of the stars of the ascend-

[1] K is practically zero for stars of classes A, F, and G.

ing group, which gives a large value of K, could be attributed to greater mass, and not merely to greater volume, it might be possible to regard K as a function of the mass. The effect of great mass might then be to produce the pressure displacement mentioned by Campbell as a possible explanation. Or, as Dr. Herassimovitch points out, a displacement of the stellar lines to the red, such as would account for the K term, might possibly result from the gravitational field in the case of great masses, in accordance with Freundlich's deduction from the theory of relativity. There appear to be some difficulties, however, in connection with the latter hypothesis, and it may be added that the Mount Wilson observers have been unable to detect any systematic effect of this kind in the case of the sun, although the calculated effect is considerably greater than the errors of observation (Mt. Wilson Report, 1914, p. 255). On either supposition, however, it seems improbable that there would be so great a difference in masses for Lockyer's two groups of helium stars as to account for the large value of K in the ascending group and its practical disappearance in the descending group.

It at least seems clear, from the above results, that K can no longer be regarded as a constant error, having a fairly definite value for each of the Harvard classes. Prof. Perrine has also recently been led to this conclusion (*Astrophys. Journ.*, November, 1916), and is inclined to the opinion that the observed residuals represent velocity displacements. Whatever the true explanation may be, Dr. Herassimovitch's investigation emphasises the importance of taking account of Lockyer's criteria in the classification of stars of the helium group. A. FOWLER.

THE POTATO SUPPLY.

THE average potato crop of Great Britain is a little over 2 million tons, and that of Ireland a little under this figure. Great Britain and Ireland together contribute rather less than 5 per cent. of the world's crop of 91½ million tons. In normal years the British Isles grow nearly, or quite, enough potatoes to satisfy home needs. Accessory supplies are, however, derived from the Channel Islands, Normandy, Brittany, and other sources.

Hence it might be doubted whether even in these exceptional times there is need for any large measure of forethought or room for much anxiety with respect to our potato supplies.

A combination of circumstances, however, has co-operated to make this year's potato crop a matter of considerable national importance.

First among these circumstances is the fact that very large quantities of potatoes are required for his Majesty's forces. Moreover, there is reason to believe that the French have been large purchasers. Secondly, last year's potato crop was below the average, both in Scotland and in certain parts of England. In some districts the crop, though fair in amount, proved to be badly diseased at lifting time; a sure indication of loss in store. Exact information as to the total yield in this country is not available, but it may be taken as probable that it does not amount to two-thirds of the average crop.

The reasons for the shortage are numerous, but one of the chief is undoubtedly the adverse season of 1916; lack of labour for hoeing, absence of supplies of potash manures, and the high price of other artificial manures also contributed to the misfortune.

In consequence of the partial failure of the crop it was foreseen that prices would rise to a high level, and it was hoped that official action would be taken while the bulk of the crop was in the ground, and before contracts were entered into. The hope was not realised. Warnings were ignored—for to warn before it is too late is to be premature. More serious than the rise in price of ware (food potatoes) was the rise in the price of seed. Scotch seed, which, together with Irish, gives a higher yield than English seed, was known to be scarce, and thrifty men, in order to secure seed betimes, paid so much as 25*l.* to 30*l.* per ton for seed of good varieties.

At this stage prices were fixed—maximum price for last year's crop, maximum for the crop not yet sown, and for the seed for sowing. The price fixed for next year's crop had the immediate effect of determining everyone whose patriotism was not very much deeper than his pocket to abandon the idea of growing potatoes, for they knew that a maximum price of 115*s.*–130*s.* per ton would mean growing the crop at a loss. Plain men were puzzled to know why a beleaguered city must at all costs save itself from a glut of potatoes. There was an outcry, and the maximum price for next year's crop became a minimum.

With respect to seed the fixed prices remain: 12*l.* per ton as a maximum, and at the present moment anyone who wants to grow potatoes can, as we are assured by the Board of Agriculture, buy the *best seed* from the Board at 12*l.*, or from any of the leading seedsmen at double the price. If the article supplied by the Board proves indeed to be the best with respect to origin, size, and trueness to name, purchasers who waited on providence will have reason to laugh at their more provident brother-growers who bought betimes. The authorities have gone one better than the parable: the late-come labourers get twopence instead of the penny earned by those who bore the heat and burden of the day. Nevertheless no public-spirited person will grumble if he can be assured that the Board has dealt justly with the grower of the seed, and is able to supply seed tubers *of the best quality* at 12*l.* per ton. Rather will he incline to a belief in miracles. The view is commonly held that there will be too many potatoes grown this year. Facts, however, do not warrant that view. There is a general shortage of corn crops, transport is disorganised, farm lands lack expert labour, artificial manures are dear and scarce, and seed is likely to be of

inferior quality. The more the situation is considered, the more imperative appears the need to cultivate every rod of fertile ground. Unless the omens are false, and whether peace come soon or no, all the vegetable produce that can be raised will be sorely needed. F. K.

PROF. GASTON DARBOUX, For. Mem. R.S.

By the recent death of the permanent secretary of the Academy of Sciences of the Institute of France, mathematical science, and all that it stands for in the evolution of human progress, has suffered a grievous loss. Of dark complexion and large build, which were a continual reminder of his southern Provençal origin, and of the exquisite courtesy which marks the French man of learning at his best, Prof. Darboux was no stranger in this country. Those who were present in December, 1907, at the great concourse which followed the remains of Lord Kelvin to his tomb adjacent to that of Sir Isaac Newton in Westminster Abbey will remember the striking figure who, in the uniform of the Institute of France, represented the sister nation among the bearers of the pall. Already in those early days of the Entente France made a point to send of her best—Becquerel, Darboux, Lippmann—to represent her in our national mourning for a man of science whose work had united so happily the genius of the two nations. Later, at the London meeting of the International Association of Academies in 1912, Darboux was naturally prominent as one of the French representatives; and, though even then showing signs of failing health, he contributed notably as usual, by his tact and moderation and sympathy, to the successful issue of business not always easy to negotiate.

Jean Gaston Darboux[1] was born at Nîmes on August 13, 1842, in a house which had once been a chapel of the cathedral. He lost his father at seven years of age; and he and his only brother were educated under the anxious care of their mother at the local lycée, attending as demi-pensionnaires, as was not unusual in those days, from six o'clock in the morning until eight in the evening. He passed on to the more special classes of the lycée of Montpelier in 1859, and in 1861 he headed the lists for admission both to the Ecole Polytechnique and to the Ecole Normale. Of these, true to his desire to devote himself to the profession of teaching, he chose the latter, thereby setting a fashion followed in later years by other illustrious men who came out high on both lists. His mother went specially to Paris in order to introduce him to Pasteur, then the scientific director of the school.

At the Ecole Normale his bent was towards geometry, and he found time for minute study of the classical works of Monge, Gauss, Poncelet, Dupin, Lamé, and Jacobi. In 1864 his own studies on orthogonal surfaces had already borne fruit in the *Comptes rendus*, and in 1866 he sustained a memoir "Sur les surfaces orthogonales" as a thesis at the Sorbonne for the doctorate in mathematical science. He then plunged into teaching, to which he had been looking forward, collaborating with Joseph Bertrand in mathematical physics at the Collège de France, and with Bouquet at the Lycée Louis le Grand; but he also found time to elaborate two of his principal memoirs, both published in 1870, one on partial differential equations of the second order, the other the famous treatise, "Sur une classe remarquable des courbes et des surfaces algébriques." In the latter work was developed the theory of cyclides, so named after the special cyclide surface of Dupin, a study which had been initiated by Moutard and envisaged under more general forms by Kummer. The Irish mathematician Casey published about the same time, and in the main independently, several very elegant and elaborate memoirs on the same topic, developed by more purely geometrical methods; and the fascination of their results and the beauty of the processes attracted great attention to the subject in this country during the succeeding years. It was another instance of the affinity of the Irish school of mathematics to the French school, on which it had for long been consciously modelled. Near the end of his life Darboux returned to this subject and prepared an extended edition of his earlier work.

From 1873 to 1878 he assisted Liouville, then of advanced years and in bad health, in the chair of rational mechanics at the Sorbonne; and some of the fruits of this course are preserved in the elegant and valuable notes, in his best geometrical vein, that he appended to an edition of Despeyrous's "Cours de Mécanique."

Darboux finally entered upon his life-work in 1880 in the professorship of Géométrie supérieure which had been founded at the Sorbonne for Chasles in 1846. As part of the activities of this chair he elaborated the great treatise on infinitesimal geometry, the "Théorie générale des Surfaces," which came out in four volumes between 1887 and 1896. This constitutes his chief expository work; into it much of his own previous researches is condensed; and, as usual with the French treatises on analysis, it ramifies into adjoining domains, such as general dynamics, whenever the methods of his exposition are adapted to illuminate such cognate theories.

He was elected a member of the Académie des Sciences in 1884, and there he gained the highest mark of the esteem and appreciation of his colleagues in being chosen as Secrétaire perpétuel in 1900. The efficiency and charm with which he executed the delicate duties of that office have been universally recognised. He held honorary rank in the Universities, amongst others, of Cambridge and Christiania and Kasan. He was elected a foreign honorary member of the Royal Society in 1900, and last autumn, just in time, he received the award of its Sylvester medal.

Joseph Larmor.

[1] Use has been made for these facts of a monograph on M. Darboux published by M. E. Lebon in 1910.

NOTES.

A STRIKING example of the utilisation of waste products was given by Mr. Forster, the Financial Secretary to the War Office, in the House of Commons on March 1. The waste product in question was fat. Everybody knows now that glycerine is obtained from fat, even if in the early days of the war this fact was new to certain of our officials whose education had, presumably, been exclusively classical, and who were therefore unaware that there was any connection between the supply of fat and the production of explosives. Beef of medium leanness contains on an average about 20 per cent. of fat, calculated upon the edible part of the joints; mutton and pork contain about 30 per cent. On heating these fats with a solution of alkali, the glycerides of which they consist are decomposed, yielding glycerine and soap. Theoretically, the pure fats should give glycerine equal approximately to 10·8 per cent. of their weight. Formerly meat scraps and other table refuse at the military camps were either destroyed or else sold for a small sum; but the authorities now have these remnants collected and sorted, in order that the fatty portions may be used for the making of glycerine. Special plants have been erected for this purpose, one in this country and one in France, and others are shortly to be installed. It was stated that the present rate of output of glycerine from the food of the troops is 1000 tons annually, and that this quantity provides propellant explosive charges for approximately twelve and a half millions of 18-pounder shells. The War Office sells the glycerine to the Ministry of Munitions for 50*l*. a ton, whereas if it were bought in the United States it would cost 240*l*. a ton.

MR. FORSTER, referring in the House of Commons to the Medical Service of the Army, stated that as regards Mesopotamia the War Office has become directly responsible for the medical arrangements in that theatre of war. The general conditions there may now be regarded as satisfactory. During the summer there was necessarily some considerable sickness, but the admission rate has steadily diminished since, and the supply of nurses and medical *personnel* is fully equal at the present time to that at the other fronts. In France, Salonika, and Egypt the general conditions are satisfactory, but in East Africa the authorities have had to contend with a good deal of malaria owing to the exceptionally unhealthy climatic conditions. One of the most remarkable features of the whole campaign is the almost total disappearance of enteric (typhoid) fever. The last weekly returns show that the numbers in hospitals suffering from this disease were: France, four cases; Salonika, nine; Egypt, three; Mesopotamia, eight; total, twenty-four cases. The number of cases of typhoid fever among British troops in France up to November 1 of last year was 1684; paratyphoid, 2534; and indefinite cases, 353; a total of 4571. In the South African War nearly 60,000 cases were admitted into hospital, and there were 8227 deaths; there were thus approximately twice as many *deaths* from typhoid fever in South Africa as there were *cases* in France up to November 1 last. The admission rate for typhoid fever among those who had not been protected by inoculation was fifteen times higher than among those who had been inoculated, and the death-rate was seventy times higher! At home the hospital system has been developed and extended, and the system of utilising the services of the voluntary aid detachments has been highly successful and is much appreciated. Arrangements have been made by which the problem of the treatment and training of the discharged disabled soldiers will be more effectively dealt with. The venereal diseases rate in the Army to-day is no higher than it was in ordinary times of peace, and every effort is being made to reduce the rate still more by the provision of lectures to the troops on the subject in collaboration with the National Council for the Prevention of Venereal Diseases.

THE report of the committee appointed by the Home Secretary to inquire into the social and economic results of the Summer Time Act, 1916, has just been issued (Cd. 8487, price 3*d*.). The committee recommends: 1. That summer time should be renewed in 1917 and in subsequent years. 2. That the period of the operation of summer time should be from the second Sunday in April to the third Sunday in September in each year. 3. That the change from normal to summer time should be made on the night of Saturday–Sunday and the reversion to normal time on the night of Sunday–Monday. 4. That the variation from normal time should be one hour throughout the whole period. The evidence presented by the committee is not of a very substantial kind, but, taking it as a whole, it leads to the conclusion "that the vast preponderance of opinion throughout Great Britain is enthusiastically in favour of summer time, and of its renewal—not only as a war measure, but as a permanent institution." To prevent loss of sleep by children being permitted to stay up beyond their proper bed-time during the long light evenings, it is recommended that all possible steps should be taken by education authorities through the school medical services and the care committees to ensure that this tendency shall be kept within the narrowest possible limits. The opinions of farmers and others concerned with agriculture as to the effects of summer time are more conflicting than those of any other interests; on many farms and in some entire districts (so far as the agricultural community was concerned) the Act was not observed at all. Representatives of the cotton trade complained to the committee of the inconvenience arising out of the necessity for lighting up the factories in the early morning in the second half of September, and it is partly to meet this objection that the reversion to normal time is to be made at an earlier date this year than last. Sir Napier Shaw informed the committee that a great deal of confusion arose with observers as regards the hours at which meteorological observations were made, and he remarked: "From the scientific point of view the discontinuity of hour introduces a defect which is fatal, and for which there is no remedy." On this matter the committee expresses the hope that the proposal for a permanent acceleration by one hour of the international service of weather reports will receive further consideration.

POLITICAL questions do not often figure in the pages of scientific journals, and the publication in *Science Progress* for January (No. 43) of a leading article, by Mr. W. H. Cowan, M.P., on "Scientific Parliamentary Reform" will undoubtedly arouse considerable discussion. In this article, which treats the present national position from a political point of view, the main issue is largely identical with that urged from the point of view of a man of science in January, 1910, by the late Dr. Johnstone Stoney, F.R.S., in a tract entitled "The Danger which in Our Time Threatens British Liberty." In the past Great Britain, after many struggles, secured a form of representative government that has been adopted as a model by all progressive modern nations But in recent years there has been an ever-growing tendency to subjugate the will of Parliament to the influence of a Cabinet autocracy which, if unchecked, will reduce what professes to be Parliamentary government to the worst form of tyranny. A study of Mr.

Cowan's article will convince the reader that at the present time the average M.P. has practically no opportunity of bringing his capabilities as an independent expert to bear on problems of national importance. Moreover, under the closure, opportunities for discussion are practically nil, except for a handful of members who are able to catch the "Speaker's eye," and the member who attempts to introduce a private Bill will soon find his attempts stifled by Ministerial and other pressure. As for the control of the House of Commons over finance, this is described as an empty boast, untold millions being voted without discussion at the fag-end of an all-night sitting. While not claiming to propose any final cure for this growing disease of bureaucratic tyranny, Mr. Cowan suggests the following possible remedies: Voting by ballot in divisions of the House; shorter Parliaments; an alteration in procedure enabling a Bill dropped in one session to be taken up at the same stage in the next session; and the more controversial proposal of "Home Rule All Round."

THE latest issue of the *Victorian Naturalist* to reach us brings the news of the death of Dr. E. P. Ramsay, of Sydney, at the age of seventy-four years. Dr. Ramsay was best known as curator for many years of the Australian Museum, Sydney, and his "Tabular List of Australian Birds" was long the standard index for Australian ornithologists.

A LETTER lately received from Dr. Ragnar Karsten, leader of the Swedish expedition in Ecuador, is dated El Tena, East Ecuador, October 10, 1916, and states that the expedition was then half-way along the difficult road from Quito to Napo, at which latter place and at Curaray ethnographical studies and collections would be made.

SWEDISH papers announce the death, on January 23, in his seventy-first year, of Dr. Edward Welander, the leading specialist on skin and venereal diseases. Many of his published investigations deal with the action of mercury. On one occasion he injected a mercurial preparation into his own arm-muscles, and followed its course through the system by a series of X-ray photographs. He fought these diseases also by popular education, and founded a home for the upbringing of children with congenital syphilis, an example followed in other European capitals.

THE agricultural institute of Alnarp, Scania, proposes to devote a plot of its land and about 4000*l.* to the erection of a building for studies in heredity, under the direction of H. Nilsson-Ehle, the recently appointed professor at Lund. It will also provide a maintenance grant of 200*l.* per annum. It is felt that such studies are of the greatest importance at this time, when Sweden is thrown on its own resources in the matter of food production, and the institute is convinced that any material sacrifices it may make for this purpose will be more than repaid by the economic results of the research, on which the institute will naturally have the first claim.

THE Daimler Company, Ltd., has placed at the disposal of the council of the Institution of Automobile Engineers a sum of money for the provision of an annual premium of 25*l.* to be granted to the graduate submitting the best paper on an appropriate subject in any session. Papers must reach the secretary of the institution, 28 Victoria Street, S.W., during September of each year.

THE following have been elected ordinary fellows of the Royal Society of Edinburgh: G. B. Burnside, Dr. B. Cunningham, T. C. Day, R. W. Dron, Prof. A. Gibson, J. Harrison, Prof. J. C. Irvine, A. King, Sir Donald Macalister, Rev. H. C. Macpherson, Lieut. L. W. G. Malcolm, A. E. Maylard, G. F. Merson, F. Phillips, Dr. H. H. Scott, Sir G. A. Smith, Dr. J. Tait, Dr. W. W. Taylor, J. M'Lean Thompson, W. Thorneycroft, and Prof. D. F. Tovey.

WE learn from the *Times* that the Reconstruction Committee which was appointed by the late Prime Minister to advise the Government on the many national problems that will arise at the end of the war has now been reconstructed. The Prime Minister will be chairman of this committee. Mr. Lloyd George will, of course, not be able to give continuous attention to the detailed proceedings of the committee, and it is understood that his deputy, on whom the work will fall, will be Mr. Edwin Montagu, the Minister of Munitions in the late Government.

THE death is announced, in his ninety-second year, of Mr. James Forrest, honorary secretary, and for many years the secretary, of the Institution of Civil Engineers. The famous "James Forrest" lecture of the institution was endowed by him a few years before his retirement, when a presentation was made to him by the council. His intention was that the lecture should illustrate the dependence of the engineer in his practical professional work on the mathematical and physical sciences. The first lecture was delivered by Dr. W. Anderson in 1893 upon the subject of "The Interdependence of Abstract Science and Engineering," and the whole of the lectures form a very valuable series.

THE report of the Philosophical Institute of Canterbury, New Zealand, for the year 1916 records that the council has recognised the importance of furthering the national movement to advance scientific research and extend the application of scientific knowledge. Addresses on "Education and our National Requirements" and "The Importance of Research to Industry and Commerce," by Mr. G. M. Thomson and Prof. T. H. Easterfield respectively, were arranged with these ends in view. In order that matters connected with research and the technical application of science should be constantly watched, the council set up a special committee, with Dr. C. C. Farr as hon. secretary. The New Zealand Board of Industries, having invited the institute to send delegates to confer with the Board on matters affecting post-war reconstruction, the council appointed the president, with Dr. Farr and Dr. Hilgendorf, to act. Application has been made for part of the 250*l.* granted by the Government for research; and investigations are being arranged on the phosphate rocks of Canterbury, the deterioration of apples in cold storage, and the electrical prevention of frosting in orchards.

SIR JAMES J. DOBBIE, president of the Institute of Chemistry, referred, in his presidential address to the institute on March 1, to the services of professional chemists in connection with the war. The institute has acted as a chemical clearing-house, assisting public departments and firms engaged on Government work to obtain the chemical service they required. Apart from that, the researches on glass initiated by the institute, particularly the work of Prof. Herbert Jackson, have proved of great value, and have been specially recognised by the President of the Board of Trade. After indicating a number of new industrial developments which call for the help of practical chemists, the president advocated the extension of the training of chemists, particularly in higher physics and physical chemistry, and, therefore, the adoption of a four, instead of a three, years' course. He em-

phasised the importance of mechanics to chemists who intend to practise in industry, and recommended a training as wide as possible for chemists generally. Dealing with the recent discussions on the subjects of education and the reform of the school curriculum, he criticised what was termed "generalised science," by which he supposed was meant a composite course, including a little physics, a little chemistry, a little biology, and a little of everything else, and suggested that school science should be as simple as possible, and that the first place should be given to mechanics experimentally treated, as being essential to the study of all other experimental science.

MR. J. W. OGILVY, secretary of the Microscopical Section of the Young Men's Christian Association, has sent us a copy of the report just issued. The object of this section is to give exhibitions and deliver lectures on microscopical subjects to the troops in the camps and hospitals in the Metropolitan and Home Counties areas; for this purpose sixty-five microscopists have volunteered their services. For the three months October to December, 1916, seventy-three exhibitions have been held and twenty-two lectures delivered, all branches of natural history, together with physiology and pathology, being dealt with. One of the most popular lectures is entitled "Some Huns of the Microscopical World," which treats of some of the disease-producing micro-organisms, and in which the opportunity is taken to refer to syphilis, its causation and spread. There is much evidence among the troops that venereal diseases are spread to a considerable extent through ignorance and thoughtlessness, and an endeavour is being made to enlighten the men upon the subject. These lectures and demonstrations have proved a great success, and it is proposed in the near future to commence a series of Saturday and Sunday afternoon rambles for munition boys.

MR. A. H. SMITH, of the British Museum, contributes to vol. xxxvi., part ii., of the Journal of the Hellenic Society for 1916, an interesting account of the history of the acquisition of the marbles of the Parthenon by Lord Elgin, and of their purchase by the British Government. The late Lord Elgin, on the centenary of the acquisition of this collection by the public, placed in Mr. Smith's hands all his papers bearing on the subject, his desire being that the episode of the marbles should appear in its due proportion in a full biography of his distinguished grandfather, the other aspects of his career being discussed by Sir Harry Wilson, K.C.M.G. We have now a full collection of the original letters and reports dealing with this collection, the glory of the British Museum. An important incident is that of the work of Signor Giovanni Battista Lusieri, by whose efforts, in a large measure, the operations were successfully completed. By an unlucky accident an important collection of drawings and some artistic objects were lost in the wreck of the *Cambrian*, a 48-gun frigate, commanded by Capt. Hamilton, wrecked on the coast of Crete on January 31, 1828. The ship was attacked by pirates, and it was necessary to abandon her at once, without saving even the ship's dog and muster-book, with the large case containing the drawings.

THERE is happily a very general desire among us that such wild spots as still remain to us in these islands should, so far as possible, be jealously guarded. Thus the announcement in the Press of February 22, to the effect that Sir Thomas Acland had placed some seven or eight thousand acres of Exmoor under the guardianship of the National Trust, will be very welcome. A lease has been granted the trust for the next five hundred years. By arrangement, Sir Thomas and his successors will continue to enjoy the rents and profits and all the ordinary rights and powers of an owner, except that the owner will have no power to develop the land as a building estate.

PROF. E. C. STARKS, in the Leland Stanford Junior University Publications, University Series, gives a valuable survey of that extraordinarily variable bone in the mandible of fishes, the sesamoid articular, illustrated by numerous figures. He confirms the opinion of Dr. W. G. Ridewood that it is to be regarded as a sesamoid. Contrary to the views of some earlier investigators, he regards the sesamoid articular as useless as a factor in the classification of groups larger than species, as it often differs within the genus. Nor until much more extensive investigations have been made will it be possible, he considers, to pronounce upon its value in differentiating species.

AMONG the vast numbers of Brent geese which visit our shores during the winter months a considerable sprinkling occurs of the American form (*Bernicla leucogaster*). Until now it has been supposed that this sub-species occurred with greatest frequency on the Northumberland coast, where, indeed, it appears to be more abundant than the British *B. brenta*; and the same is apparently true in regard to its numbers on the south-east coast of Ireland. While it has been by no means regarded as a rarity in Scotland, it seems possible that further observation may show that it is of far commoner occurrence than was supposed. For the Misses Rintoul and Baxter, in the *Scottish Naturalist* for February, record the fact that an examination of the specimens of Brent geese in the Royal Scottish Museum shows that the large majority belong to the American race.

SIR FREDERICK TREVES, in the *Observer* of February 25, directs attention to the grave results likely to follow from the introduction of the American grey squirrel into Richmond Park. Not only has it driven out our native red squirrel, but it has also now spread beyond the confines of the park into adjoining gardens, working serious damage there. "They eat everything that can be eaten, and destroy twenty times more than they eat." The buds and shoots of young trees, apples, pears, and stone fruits, peas, and strawberries are all laid under a heavy contribution. Already it seems the Office of Works has given orders for the destruction of these pests. The order, however, has come somewhat late, for they have already made their way into the open country of Surrey with a steady persistence and in good force. "When it has reached the fruit-gardens and young plantations of Surrey and Kent, we shall hear more." We are evidently in grave danger of having another very practical lesson in the folly of "acclimatisation," of which the rabbit in Australia forms a familiar and awful example.

ALL interested in the formation and management of War Food Societies will find useful guidance in Special Leaflet No. 32 of the Board of Agriculture and Fisheries, of which a revised edition is now available. Examples of what has already been done by war food societies and women's institutes since the first issue of the leaflet are now given. It is of interest to note that the Women's Institute at Criccieth, with a membership of about eighty, realised in the first nine months more than 200*l.* by the sale of surplus produce beyond home requirements. Instructions are given as to how a food society or women's institute may be started, and numerous suggestions are made as to the different directions in which their activities may be exercised. Special attention is directed to the powers now conferred

upon the Board of Agriculture and Fisheries for securing the use of unoccupied land for purposes of food production.

IN view of the difficulty of securing delivery of basic slag, superphosphate, and other phosphatic manures, the President of the Board of Agriculture and Fisheries asks farmers not to apply phosphates to meadows and pastures during the remainder of the present season. All available supplies should be reserved for other crops, especially for roots and potatoes. Having regard to the short supplies, it is not advisable to apply more than three-fourths of the usual dressings of these phosphatic manures, since better results may be expected from the same total weight of manure if the whole area under any particular crop is manured lightly than if a part is heavily dressed and the balance left without artificial manure. This rule applies only where the land is uniform in quality. In those cases in which farmers know that certain fields are poorer than others the manurial treatment must be adapted to the special conditions. Where land in good condition can be given full dressings of farmyard manure, artificial phosphatic manures may often be omitted without materially reducing the crops.

AT the meeting of the Society of Glass Technology, held at the University of Sheffield on February 15, some samples of glass manufactured from British sands were exhibited by Mr. C. J. Peddle, but the principal business of the meeting was the discussion of the effect of the temperature at which the annealing of glass is carried out on the time required by the process. Contributions to the discussion were made by Mr. F. Twyman, of Messrs. Adam Hilger, Ltd., London, and by Mr. S. English, of the Glass Technology Department of the University of Sheffield. As the temperature is raised towards the softening point of the glass, the speed at which the internal strains disappear is increased, and the object is to find for each type of glass the highest temperature at which it is safe to carry out the annealing process. The observations are conveniently made on a glass rod mounted between Nicol prisms, so that light passing through the system shows the rings and cross characteristic of a uniaxial crystal. As the annealing proceeds the rings disappear, and the times of disappearance of the last four rings were found in a particular sample of glass to be as follows: At 500° C. 1230 minutes, at 550° C. 50, at 600° C. 20, and at 625° C. 12. These temperatures are all considerably below that of actual softening of the glass.

VOL. xii. of "Contributions from the Jefferson Physical and the Cruft High-tension Electrical Laboratories of Harvard University" for the year 1915 consists of reprints of nineteen papers, the outcome of researches aided financially by the Coolidge fund for research, the Bache fund of the National Academy of Sciences, and the Rumford fund of the American Academy of Arts and Sciences. The volume extends to 400 pages, and is a record of which Harvard may well feel proud. The Cruft laboratory provides two of the nineteen papers—one by Mr. F. Cutting on the design of radiotelegraphic transformers, another by Mr. E. L. Chaffee on coupled circuits. Of the Jefferson laboratory contributions, that of the director, Dr. T. Lyman, is of special interest, as it extends the ultra-violet end of the spectrum to wave-length 600 Ångström units. Dr. P. W. Bridgman's five valuable contributions occupy a large share of the volume, and deal with the effect of great pressures on the temperature and velocity of transition of polymorphic forms of the same substance into each other. Altogether, 150 substances have been examined, and it is unfortunate that the polymorphic diagrams obtained show no tendency to fall into simple types. The subject appears to be very complicated, and Dr. Bridgman suggests that the explanation of the great variety of behaviour of the different substances must be sought in the actual shapes of the atoms.

A COPY of the Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, 1916, has been received from Messrs. Charles Griffin and Co., Ltd. This, the thirty-third annual issue of a useful work of reference, contains a record compiled from official sources of the work done in science, literature, and art during the session 1915–16 by numerous societies and Government institutions. The list of societies dealt with is remarkably comprehensive; but the plan of selection is not always clear. Under the section entitled Psychology, for instance, space has been found for particulars of the Nature Study Society and the School Nature Study Union, but nowhere in the volume have we found data concerning the work of, say, the Association of Public-School Science Masters. Similarly, under the section Literature and History, the English Association is included, while the Historical Association is overlooked. The man of science, however, will find the volume as useful as ever in discovering the work done in his particular subject during the year under review. The book is published at 7s. 6d. net.

AN interesting and very full botanical catalogue (New Series, No. 77) has just been issued by Messrs. J. Wheldon and Co., 38 Great Queen Street, W.C. It comprises floras of all countries, and is arranged most conveniently according to the countries dealt with. Many of the works are scarce. We notice that several belonged to the late Sir Joseph Hooker.

PROF. FRASER HARRIS writes to correct an error made by him in his letter in NATURE of January 18 (p. 389) on the introduction of the term "metabolic." He referred to the first edition of Foster's "Text-book of Physiology" as having been published in 1883, whereas it appeared in 1877.

OUR ASTRONOMICAL COLUMN.

EFFECT OF HAZE ON SOLAR ROTATION MEASURES.—Attention has previously been directed to Mr. De Lury's suggestion that the apparent variations in the rate of solar rotation, as determined by the spectrographic method at different times, and from different lines, might be accounted for by variations in the haziness of the sky (NATURE, vol. xcviii., p. 99). Messrs. St. John and Adams have since made observations to test the possible influence of haze, and have found that to obtain equality of density in photographs of the spectra at points just outside and just within the sun's limb, it was necessary to give exposures in the ratio of 100 to 1. These observers concluded that, under the usual working conditions at Mt. Wilson, scattered radiation is a negligible factor, and is not a probable source of error in the observations of solar rotation (Journ. R.A.S., Canada, vol. x., p. 553). In a further note on the subject (*ibid.*, vol. xi., p. 23) Mr. De Lury points out that the density of a negative is proportional to a power of the time, usually within the range 0·6 to 0·9, and that equal densities with a ratio of 100 in the times of exposure would correspond to a ratio of scattered light to limb light ranging from 6·3 to 1·6 per cent. A probable value would be about 4 per cent., which would produce about half the effect noted in the Mt. Wilson observations, and, allowing

for other circumstances, could conceivably account for the whole effect. If atmospheric haze be proved insufficient, it is alternatively suggested that the differential effects may possibly be accounted for by assuming the production of a spectrum of non-rotating matter in the solar atmosphere.

THE NINTH SATELLITE OF JUPITER.—An investigation of the ninth satellite of Jupiter has led Messrs. Nicholson and Shapley to estimate its diameter as lying between 11 and 17 miles (*The Observatory*, vol. xl., p. 107). From photographs of this tiny object taken with the 60-in. reflector at Mt. Wilson, the photographic magnitude at mean opposition was found to be 18·6, as compared with 17·5 and 18·0 for the seventh and eighth satellites respectively. Allowing for a probable colour-index of one magnitude, the angular diameter of the ninth satellite at mean opposition works out at 0·006" or 0·009", according to the value adopted for the visual albedo, and these lead to the limits of diameter stated above.

GERMANY'S EFFORT TO OBTAIN NITROGENOUS COMPOUNDS.

ALTHOUGH elementary nitrogen is not only useless, but positively antagonistic, to the life of plants and animals (except to that of some bacteria which take free nitrogen from the atmosphere and convey it to the roots of leguminous plants), combined nitrogen is absolutely necessary for their metabolism. Animals obtain nitrogen from the vegetables they consume, plants from the nitrogenous constituents of the soil. The soil obtains part of its combined nitrogen from decaying vegetable matter and from the waste products of animals; the remainder has to be added. The two chief forms in which it is added are sodium nitrate and ammonium sulphate, which to a large extent are interchangeable. But for the manufacture of explosives sodium nitrate is absolutely necessary and ammonium sulphate useless. Germany, foreseeing that its supply of Chilean nitrate would be cut off by the blockade of the British Fleet, was faced with irremediable disaster unless it could lay in a sufficient stock before declaring war, or devise methods of synthesising nitric acid. The manner in which this difficulty has been overcome is described by Prof. Camille Matignon in the *Revue générale des Sciences* (January 15 and 30). Before the war Germany was the greatest consumer of combined nitrogen. In 1913 the consumption amounted to 750,000 tons of Chilean nitrate, 35,000 tons of Norwegian nitrate, 46,000 tons of ammonium sulphate, and 30,000 tons of cyanamide. In 1913 great efforts were devoted in Germany to the preparation of materials necessary for war, and no attempt was made to conceal them. The German Ammonium Sulphate Syndicate had a reserve of 43,000 tons, and on the declaration of war there was probably a stock of 100,000 tons of Chilean nitrate. Immediately after the battle of the Marne, when a long war was evidently certain, the production of artificial nitrates and of ammonium sulphate was stimulated, the Badische Aniline Company and Bayer and Co. being subsidised to the extent of 30,000,000 marks for the installation of factories to convert ammonia into nitric acid. In peace time 550,000 tons of ammonium sulphate were produced annually in Germany, but this output was reduced once war was declared. As this substance is a by-product in the manufacture of gas and cast-iron, people in Germany were instigated to use gas and coke instead of coal, and by such means an annual output of 250,000 tons of ammonium sulphate was attained. The problem of converting the ammonia into nitric acid was solved by the Frank and Caro and the Kayser processes. A French chemist, Kuhlmann, had discovered that ammonia is oxidised to nitrogen peroxide when mixed with air and passed over warm, finely divided platinum. The reaction was employed on a commercial scale by Ostwald, and improved both by Kayser and by Frank and Caro. By the end of 1915 the Anhaltische Maschinenbau Society of Berlin had established thirty installations for the conversion by Frank and Caro's process, and these had a capacity of more than 100,000 tons of nitric acid per month. But this was only one of the methods adopted. Given a cheap source of electrical energy, it was known to be commercially practicable to prepare nitric acid by the direct oxidation of nitrogen in the electric flame, and this process had been established in Norway by Birkeland and Eyde, who used the waterfalls as a source of energy. The Germans have established a factory employing Pauling's process (a modification of that of Birkeland and Eyde) at Muhlenstein, in Saxony, in the neighbourhood of the lignite beds, which form the source of energy, and this has an annual output of 6000 tons of nitric acid.

The third principal method adopted for the preparation of combined nitrogen was the direct synthesis of ammonia. Bosch and Mittasch, two chemical engineers of the Badische Company, had adapted Haber's synthesis to industrial conditions, and the company had established a factory with an annual output of 30,000 tons of synthetic ammonium sulphate. In April, 1914, the company increased its capital in order to raise the output to 130,000 tons, and after the battle of the Marne it was subsidised by the German Government to increase the production to 300,000 tons.

Before the war the production of cyanamide in Germany was comparatively small, but it has increased largely under Government stimulus. The cyanamide manufacturers desired a monopoly, but this was opposed by the Badische and other companies and by the gas manufacturers, and the project seems to have been abandoned.

In the direction of the manufacture of manures, it was necessary to economise sulphuric acid, so ammonia was neutralised with nitre cake, and the resulting mixture of sodium and ammonium sulphates was mixed with superphosphate. Moreover, it was found that superphosphate will absorb gaseous ammonia, and although the calcium acid phosphate is thereby converted into the insoluble tricalcic phosphate, it is formed in an easily assimilable condition, and the product is found by experience to act both as a nitrogen and phosphorus manure.

Prof. Matignon seems to be correct in claiming that chemistry has saved Germany from disaster.

E. H.

SUBSIDENCE RESULTING FROM MINING.

THE very important question of subsidence resulting from mining operations has recently been discussed in a bulletin issued by the Engineering Experiment Station of the University of Illinois. The report is prepared by Dr. L. E. Young, mining engineer for the Illinois Coal Mining Investigations, and Prof. H. H. Stock, professor of mining engineering in the University of Illinois, under a co-operative agreement between the University, as represented by its Engineering Experiment Station, the Illinois State Geological Survey, and the United States Bureau of Mines. Apparently, whilst we in this country content ourselves with talking about the need for closer co-

operation between the technical faculties of our universities and the industries concerned, in America such co-operation is already an established fact, and reports such as the present one show evidence of its value.

This bulletin is merely a preliminary one, presenting a complete and concise account of what is known up to the present on the subject of subsidences due to mining operations, and the authors have done their work in a most thorough and painstaking fashion, and have missed very little of the published information on the subject, in spite of the difficulty of bringing it together from the large number of scattered records through which it is disseminated. It need scarcely be said that the subject is one of the greatest importance in this country, where so many of our most densely populated industrial centres are situated upon the coalfields themselves. The problem whether large masses of coal should be left in the form of supporting pillars, and thus be permanently lost to the nation, or to what extent it is advisable to remove them, with the risk, or even with the certainty, of causing a certain amount of surface damage, is obviously one of first-rate importance, especially at times like the present, when the proper conservation and full utilisation of our natural resources demand our utmost attention.

Messrs. Young and Stock have contented themselves with summarising the theories on subsidence promulgated by various writers, notably the Belgian, French, Prussian, and Austrian theories; there cannot really be said to be any British or American theories, although various British engineers have proposed formulas, notably for determining the angle of "draw," and the size of the coal pillars that must be left in order adequately to protect any given area of surface; the wide divergence of these various formulas is well shown by a diagram, reproduced from a paper by Prof. George Knox, which shows that some of these give results ten times as great as those given by others.

The introductory notice to the present bulletin suggests that the Illinois authorities propose to study the problem in a systematic fashion, by taking careful levels across selected groups of mines at regular intervals, and simultaneously noting the conditions of the underground workings, such observations to be continued for a number of years, when it may be hoped that it will be found possible to correlate surface subsidences and underground workings, and thus to obtain data that will enable the conditions of maximum economy to be determined. This is a subject that might with the greatest advantage be taken up on similar lines by one or other of the committees formed to deal with industrial research in this country.

H. L.

FURTHER STUDIES IN PLANT GENETICS.

THE September number of the *American Naturalist* (vol. l., No. 597) is devoted to studies of inheritance in plants. Dr. H. H. Bartlett writes on "The Status of the Mutation Theory, with especial reference to Œnothera." He "finds incredible the arguments that have been brought forward in favour of the idea that mutation and Mendelian segregation are the same." Nevertheless, it still remains to be decided "whether or not mutation is always, or ever, conditioned by previous hybridisation." Dr. O. E. White describes some researches in continuation of Mendel's original subject—the inheritance of cotyledon colour in Pisum. Alleged differences between the colour of segregated seeds of the F_2 generation and those of the original parents are attributed to environmental changes: yellow-cotyledon varieties may produce green seeds because of immaturity, absence of sunlight, or excess of moisture, while green-cotyledon varieties may fade to yellow or yellowish-green through excess of sunlight. In one variety—"Goldkönig"—with yellow cotyledons, the yellow colour is, contrary to the usual rule, recessive to green. This form "may be regarded as lacking both the factor for causing green pigment and the factor for causing that pigment to fade on the maturity of the seed." When "Goldkönig" is crossed with yellow-seeded varieties in which yellowness is dominant, the F_1 generation are all yellow-seeded, and the F_2 generation are segregated in the proportion of three green to thirteen $(9+3+1)$ yellow.

"Inheritance of Sex in the Grape" is discussed by W. D. Valleau. Wild vines bear flowers which are functionally either male or female, but the carpels or pistils are respectively present in a reduced condition; the plants are thus transitional between the hermaphrodite and the diœcious form. Functional hermaphrodites, however, appear in cultivation. Breeding experiments suggest that "both the staminate and functionally pistillate vines carry the determiners for femaleness and maleness, respectively, partially suppressed."

The *Journal of Genetics* for September (vol. vi., No. 1) is completely occupied by Prof. A. H. Trow's analysis of form and inheritance in the common groundsel (*Senecio vulgaris*). In a long paper he discusses the number of nodes and their distribution along the main axis in this species and its segregates. Dividing the families of plants studied into "low" (9–16 nodes), "medium" (18–26 nodes), and "high" (30–31 nodes), he finds that medium characters are dominant to both low and high, and infers, therefore, the existence of two pairs of alternative determinants. However, from the cross "medium" × "high" there emerge families with from 36–39 nodes, forming a "very high" group; this "segregates out from 'high' as a recessive." From the cross "low" × "high" other anomalous results were obtained, and the author foresees many years' work before definite conclusions can be reached. In a short paper Prof. Trow discusses the inheritance of "albinism" in groundsel; he finds that in some forms the expected ratio of green to white plants as 15 to 1 is obtained in the F_2 generation; in others it is unaccountably departed from.

THE ORGANISATION AND DEVELOPMENT OF CHEMICAL INDUSTRY AND RESEARCH.[1]

SOUTH AFRICA is a country which has hitherto existed, and still does at the present moment exist, on its rich stock of raw materials. Its exports, in addition to the raw products of agriculture, are chiefly metals, crude and unrefined, and diamonds uncut. The chief chemical industry is the preparation of raw gold bullion from the quartzitic ore of the Transvaal. This is carried out in three operations —the first being fine pulverisation by mechanical means; the second, amalgamation with mercury; and the third, solution of the unamalgamated gold still remaining by means of sodium cyanide solution, followed by reprecipitation with excess of zinc shavings and final treatment of the metal, so as to get rid of as much of the base metal present as possible before pouring into commercial bars. The major portion of the plant necessary for these operations consists of iron and steel, and the raw materials for their manufacture exist in comparative abundance in the Transvaal. A thorough and scientifically com-

[1] From the presidential address delivered to Section B—Chemistry, Geology, Metallurgy, Mineralogy, and Geography—of the South African Association for the Advancement of Science at the Maritzburg meeting, July 4, 1916, by Prof. J. A. Wilkinson.

plete investigation of these has not yet been undertaken, but in the interests of the country at large and not merely of the metal industry this should be one of the first, since iron is the most important necessity for industrial progress of every kind. The normal value of the iron and steel imports into the country annually is almost one million pounds, and with an expanding population this must rapidly increase, as there is, practically speaking, no industry, operation, or even trade for which it is not necessary in some form or other. One small manufactory is working at Vereeniging, but this is not engaged in the production of cast iron from the raw ore and its subsequent conversion into steel of known and definite composition; and, further, what is being done is not, so far as I am aware, under strict chemical control, by which means alone can proper and definite results be achieved.

The function of the chemist in the control of matter and its energy content is imperfectly, if at all, understood, even in industries such as this, where one might at least expect that the methods which have been successful, and hence adopted in their entirety in other countries, would be followed here.

The second process mentioned involves the use of mercury, which must necessarily be imported at present. The case, however, is otherwise so far as sodium cyanide and zinc are concerned, the imports of which amount to half a million sterling, and both of which can be manufactured here. The former can be obtained indirectly from atmospheric nitrogen through cyanamide, which would find great use as an artificial manure, and thus stimulate agricultural progress. In point of fact, the Rand may be said to be primarily responsible for this great and growing industry, since it was the search for a new method of preparing cyanide that first discovered the reaction. Zinc blende is also found native, and the winning of the metal offers no great difficulty.

The mining of gold ore or other mineral deposits would be, practically speaking, impossible without the use of explosives, and to meet this necessity three large explosive factories have been established in the country, all of which are entirely dependent for their raw materials on other countries. The value of these imports in 1913, the last completely normal pre-war period, was as follows:—Sulphur, 78,386*l.*; nitrates, 235,984*l.*; glycerine, 563,014*l.*; or a total of 877,384*l.*, iron pyrites not being given. Of these, no large deposits of sulphur or pure pyrites are known to exist in South Africa, but nitric acid and its salts can now be prepared in any quantity from the nitrogen present in the atmosphere, and glycerine is a by-product in the manufacture of soap, factories for which have recently been erected here.

The production of the oils for the latter purpose would necessitate the provision of artificial fertilisers, an industry of prime importance for the progress of every branch of agriculture. Happily the problem of the transference of atmospheric nitrogen to the requirements of the soil, first stated by Sir William Crookes in his classic address to the British Association at Bristol in 1806, has now been solved in various ways, two of which have been indicated, and would therefore serve, if established, a double function. Unfortunately deposits of potassium salts or mineral phosphates of any large extent and degree of purity have not hitherto been discovered here; but in this respect South Africa is in no worse case than most other countries, and hence this problem is by no means insoluble. The manufacture of superphosphate, however, could and should be undertaken, the value imported in 1913 being 95,273*l.*, and of raw phosphates only 1705*l.* It should also be mentioned in this connection that more than 13½ million pounds of basic slag, a by-product of the steel industry, were imported in 1914—another valid argument for the creation of the latter. With regard to potassium salts there are no deposits of easy chemical access outside the celebrated Stassfurt beds, but there are sources within South Africa which could be realised if the necessity arose.

Returning again to the consideration of the exports of the country, we find that copper ore and matte, tin ore, lead ore, and raw asbestos, along with coal and diamonds, form the remainder. It is, indeed, a sad reflection that we must needs export these raw materials, as such, without making even the slightest attempt to extract their valuable contents or work them up in any manner whatsoever, but rather in addition pay freightage on admixed dross. A pitiable confession of failure in very truth, since the paths are easy and rendered still more so by the value of the prospect! If the Chinaman and the Malay are capable enough to win the tin from its ore, why should we hesitate?

A successful industry must be founded upon, and controlled by, true scientific knowledge, and the transformations of matter form the province of the chemist, whether it be the manufacture of the food on which we live, the bricks, lime, and cement with which we build our homes, the medicines to cure our infirmities, the paper and ink to disseminate and preserve our ideas, or the explosives we use as weapons of destruction.

South Africa has been endowed beyond measure with rich stores of useful minerals, and whilst these are being exploited she is dependent entirely on others to supply her most elementary wants. Thoughtless criticism might saddle me with lack of a due sense of proportion in that the economics of these possible industries have been left wholly out of consideration. In this regard I maintain that the duty of a country is to its own people, and the primary necessity is to furnish, so far as it can do so, its own immediate requirements. South Africa is not nearly at present so self-contained as is possible, and hence the necessity for the establishment of chemical industry in our midst is, in every sense, a vital one. Private enterprise has to some extent made a beginning, as illustrated by the success of the soap and cement factories established within the last few years, but the coal industry is still confined to the utilisation of the raw material accompanied by the waste and loss of its most valuable by-products.

There are two points of view which make this particular industry of supreme importance—first, the defence of the country; and, secondly, conservation of its natural resources. Phenol, benzene, and toluene are three of the most important distillates obtained from coal tar, and apart from their own use as motor fuels, when treated with nitric acid these substances yield on one hand the highest explosives at present known, and on the other the mother substances for the preparation of dyes, drugs, and perfumes.

Lord Beaconsfield once said that the prosperity of a country could be gauged by the extent of its chemical industry, a statement which was received by his contemporaries with scorn and derision. The years which have elapsed since then have proved, as is often the case, that his words were not the accident of an impulsive verbosity, but the reasoned verdict of a deliberative mind. The realisation of this dictum has been most profoundly shown by the stupendous progress in chemical industry made by Germany during the last forty years, especially in the domain of organic chemistry.

It may appeal to some to state here that Germany's great chemical factories, each with a capital of from one to two million pounds, paid dividends out of

profits varying from 14 per cent. to 30 per cent. in 1913, and as a specific example may be quoted the firm of F. Bayer and Co., of Elberfeld, which on a capital of 1,800,000*l*. made a net profit of 838,092*l*., figures which remind one of a rich Transvaal gold mine.

If we leave out of consideration the exploitation of her metalliferous minerals, which will in the not far distant future be but memories, South Africa may be considered as a country where chemical industry is, practically speaking, non-existent. Hence, to prepare the nation for the future prosperity we should so earnestly desire to see attained, the obligation rests upon this generation to develop, at the earliest possible moment, those chemical industries, in the first place, needful for its own existence, and only when this has been achieved to attempt an expansion beyond its borders.

The second portion of my theme relates to the organisation of chemical industry and the part which research should play therein. Reference has already been made to the enormous progress which Germany has made in this direction, but, unfortunately, it has required a war of the present dimensions to pierce the armour-plated conservatism of the governing classes in England, and, even yet, it is a matter of grave doubt whether much impression has been made.

By way of preface it would, perhaps, at this stage be of interest to take a few illustrations of the manner in which some of Germany's chemical industries have risen to their present state of flourishing activity, and although the story is an oft-repeated tale, constant reiteration does not yet seem to have brought home the lessons it teaches. I shall first refer to the synthetic preparation of indigo.

The synthesis of indigo was first accomplished by Nencki in 1876, but it was not until Bäyer and his pupils had five or six years later thoroughly investigated and proved its constitution that simple methods for its synthesis became available. The next step, namely, the translation of the laboratory methods thus discovered into commercially economic processes, proved a source of extreme difficulty, in which success was only achieved after nearly one million pounds had been spent on innumerable and laborious experiments, and at the end of seventeen years' work, artificial indigo prepared from the naphthalene of coal tar being first put on the market in 1897. If anything can excite our admiration, surely this example of one of the finest industrial achievements known to science should do so. The result of this vast amount of labour and expenditure is shown in the following table given by Prof. P. F. Frankland in 1915 in a paper on the chemical industries of Germany:—

Indigo.

	British East Indies		Germany	
	cwt.	Value of exports £	Imports £	Exports £
1896	188,337	3,569,670	1,036,000	319,550
1899	135,187	1,980,319	415,450	392,250
1902	89,750	1,234,837	184,350	923,100
1905	49,252	556,405	60,100	1,286,050
1908	32,490	424,849	44,100	1,932,750
1911	16,939	225,000	22,300	2,091,500
1913–14		60 to 70,000		

In 1895–96 the acreage under cultivation was approximately 1,400,000 acres, and on December 31, 1915, the *Indian Trade Journal* (Calcutta) published an estimate that the total area in 1915 was 314,300 acres, as compared with 148,400 acres in 1914, this increase being due to the high prices ruling on account of the war and the cessation of the German industry. The total yield was estimated at 39,000 cwt., as against 25,200 cwt., the revised estimate for 1914–15, and the average output per acre 14 lb., as against 19 lb. in the preceding year. The price of indigo (100 per cent.) in 1897 was 16*s*. per kilo, and in 1913 7*s*.

The knowledge of what was being done in Germany prior to the advent of the marketing of synthetic indigo was not unknown to the Indian planters, but they were sceptical of the results, many believing that it was an impossibility to prepare the substance from coal tar, with the result that, practically speaking, they took no steps whatever to improve either the yield per acre or the quality of their finished product. Having thus lulled themselves to sleep, their awakening in 1897, when synthetic indigo was placed on the market at a price much below that demanded for the natural substance, was somewhat of a bolt from the blue. Owing to the stress of the competition, which they at last realised would take place, they attempted some improvements; but, as seen above, they were somewhat belated. It is difficult to predict with any degree of accuracy whether the natural product would have been entirely ousted had there been no war, because tradition is hard to kill, and there are still dyers who prefer to use the natural dye. On the other hand, there can be no doubt that the production of the latter would have been insignificant in comparison with that of the synthetic material, as happened in the previously well-known and analogous case of the dye alizarin, formerly extracted from madder-root. The indigo fields would have shared the same fate as those of the madder.

The tannin industry in this province is in a similar position to that in which the indigo industry found itself about 1880–82. The master synthesis of tannin was effected in 1913 by Prof. Emil Fischer and Dr. Karl Freudenberg in Berlin. The formula of tannin is now known with a great degree of certainty, and the researches are still being continued. The next step is the commercial utilisation of this knowledge, which means the synthetic production of artificial tannin on a commercial scale from raw materials found in Germany. This, as stated above, in the case of indigo took seventeen years' work and one million pounds in money.

The value of the tannin bark industry to Natal is approximately 300,000*l*. per annum.

The problem which confronts the industry in this province is therefore how, whilst there is still time, to protect it against any competition which might possibly arise from the presence on the market of an artificial substitute. The answer to this may be put in the form of a question. If, during the years 1880–96, the indigo planters of India had invested one million pounds in the scientific investigation and development of their industry, would they have for one moment feared to have faced competition at the end of that period? This would have meant an expenditure to the extent of between 50,000*l*. and 60,000*l*. per annum for seventeen years invested so as to obtain results which would not only have made the future secure, but at the same time would also have increased the output annually during the period of its outlay. In point of fact, it would in all probability have placed vegetable indigo beyond competition. Moreover, just as India was compelled to export the indigo which she grew, so also must Natal at present export her tannin bark until the chemical industry of leather manufacture be established here, in which case the leather would be required to stand the strain of the competitive market. In passing, it may be noted here that of the twenty-five large classes into which Germany officially divides material connected with chemical industry, one of the divisions is "tanning extracts" and another "dyes and dye material."

In both these industries, the production of indigo and tannin, the problems are so very similar that the lesson of the former should be the incentive for the latter in the superlative degree. It is oft-times the wail of the profitmonger that the industry will not "stand the expense," and in annual balance-sheets we look in vain for the record of "investments" in the future of the industry itself. The work of the botanist and chemist is the corner-stone upon which these organisations must not only be built up initially, but also must be conducted throughout. Each must have had the highest training possible, must be thoroughly skilled in his work, thoroughly conversant with all that has been done, and must be selected for the work on these grounds and no other. They must be provided, so far as they can be, without stint or question with all that they deem necessary for the prosecution of their investigations, and results will follow. The days of rule-of-thumb experience, the legacy of a former generation, are as dead as the dodo, and he who still clings to them will be left behind his more enlightened contemporaries as the cab-horse is outdistanced by the aeroplane.

Chemical industry requires a complex organisation beginning with the chemist and ending with the patent agent and advertising salesman, sometimes also the machinery for running to earth patent thefts and fraudulent imitations.

But at the outset the chemist is the most important factor in chemical industry, because it is in the first degree upon his work that the operations depend. This may seem to some a self-evident truth, but, as a chemist, I can give the assurance that it is, unfortunately, otherwise in most instances in South Africa, with, of course, results which are easily foretold; in fact, this is one of the main reasons why our chemical products are not up to the standard of imported goods. Given the chemist and the problem of the industry to be undertaken, the next procedure is its complete investigation—in other words, to ascertain as much as possible of what is already known, for which access to a good technological and scientific library is required, and then to carry out, after complete analyses of the raw materials have been made, such tests on a small scale as will give some clue to the difficulties to be encountered on the large scale, for which purpose the establishment of a properly equipped laboratory is indispensable. If these meet with success, and the industry is undertaken, the laboratory can be utilised to aid the engineer in selecting the best materials of construction, until such time as it is necessary for controlling the daily routine. At the same time, it should serve as an instrument of research with the view of improving methods of daily control, methods of manufacture, and the discovery of new methods or processes. Whether any or all of the functions be efficiently performed depends on the equipment and staff of the laboratory, but more especially on the man who is the head. Routine operations soon become to a certain extent standardised, and can be carried out efficiently by well-trained assistants, but research work of the beneficial kind can only be effectively performed by the head of the laboratory in touch with every phase of the manufacturing process, or by chemists specially appointed for this purpose working independently. The sad aspect of the special cases with which we are concerned here is that it has hitherto been considered sufficient for these industries to employ business men and engineers alone, all excellent in their own lines, but quite unfitted to govern an industry the fundamental basis of which is a chemical process. This, in fact, is one of the chief reasons why England lost her supremacy and was outstripped by Germany, and the appreciation of this fact at the present moment by the Americans is manifesting itself in a keen endeavour to take the lead.

Another reason is that Germany has appreciated to the full the value of scientific research and education, and it is necessary for us to realise this in like measure if we are to utilise efficiently the abundance of raw material found in this country. We have seen above in the case of one industry the vast sums of money the Germans were willing to spend to effect its capture, and this was strictly in keeping with their general policy, both on the part of the State and the individual. That the Empire is beginning at last to appreciate this is shown by the steps being taken in England, Canada, and Australia. Little has, as yet, been done in England compared with what we should expect, but this may be partly accounted for by the war. The Canadians, at the instigation of Lord Shaughnessy, have made a beginning in the establishment of the Canadian Research Bureau at Montreal, thus seconding the excellent work which has been accomplished in recent years by their Mines Department. The proximity of the United States will doubtless assist in making for efficiency, as the work of the scientific departments attached to their bureaux of agriculture, geology, mines, commerce, standards, etc., is too well known to need description. The Australian Government has endowed a similar institution, the Commonwealth Institute of Science and Industry, to the extent of half a million pounds as a beginning, the object in both cases being the development of the natural resources for the benefit of the country in the first, and of the Empire in the second, place. So far as I am aware, in South Africa nothing has yet been done in this direction other than the meeting of the scientific societies of the Rand held recently in Johannesburg, which laid stress on this matter and formed a committee to further the project.

No opportunity like the present has ever before presented itself, and the cessation of the war will witness the still fiercer struggle of industrial competition, for which we must gird on our armour. At present we are, as I have shown, exporting our raw materials and importing the articles manufactured from them; hence our first and foremost need is to attempt to make ourselves independent of others, so far as our own wants are concerned. For this purpose research is necessary, and, in my opinion, the prime mover must be the State, since its proper execution demands, if performed efficiently, an organisation which is beyond the scope of the individual. It would take too long to enter fully, as the subject most rightly merits, into all the details of its requirements, and I shall therefore content myself with a brief summary of the most essential considerations and necessities. In the first place, however, I desire to explode a popular fallacy, that there are two kinds of research, which have been miscalled pure and applied research. They correspond to the undignified and unworthy divisions into which even science itself has been classified. If research be undertaken, as it is, to thrust back the boundaries of the unknown, and to widen the areas of existing knowledge, then, no matter if the purpose for the moment be, in a sense, the abstract, such as the proof or establishment of a law, principle, or hypothesis, or the concrete, such as we find exemplified in the successful development of the contact method of manufacturing sulphuric acid, as a result of the commercial preparation of indigo, it is somewhat of an anachronism to draw a sharp line of division. More especially is the practice to be condemned, since in the popular mind research of the former kind is supposed to have no utility whatever, whereas without it the latter would be absolutely impossible, and hence in any scheme which may be put

forward it must claim the part to which it is justly entitled. The steps which are necessary here for this work are as follows:—

1. *Preliminary.*—(*a*) A complete census of existing laboratories and workers; (*b*) a complete census of facilities for the education of scientific workers of all kinds and classes; (*c*) a complete census of all manufactures, their location, methods, raw materials, and output; (*d*) a complete census of all known existing raw materials of the country, which might be put to use for manufacturing or other purposes; (*e*) the collection of information from, and reciprocity with, organisations having similar objects throughout the Empire, and in Allied or friendly States.

2. *Standardisation.*—(*a*) Of scientific instruments of all kinds, whether used in laboratories or works; (*b*) and scientific control of apparatus and materials required in research.

3. *Initiation.*—The appointment of a central council which shall (*a*) receive and suggest problems for research; (*b*) by the organisation of manufactures of the same or similar products, ascertain what is necessary for their progress; (*c*) keep in close touch with all the universities and scientific societies in the country.

4. *Assistance.*—(*a*) By endowments to laboratories and workers; (*b*) by the collection, publication, and dissemination of information; (*c*) by the establishment and endowment of libraries; (*d*) by the advancement of scientific education in schools, colleges, and universities; (*e*) by increasing the equipment, etc., of existing laboratories, and the establishment of new ones; (*f*) by the provision of laboratories for carrying out suggested industrial processes on a small commercial scale with the sanction and approval of the central council.

5. *Co-ordination.*—(*a*) By annual reports from all laboratories; (*b*) by bringing all workers in the same branch together; (*c*) by the dissemination of information respecting similar work being done elsewhere; (*d*) by annual congresses of all scientific societies; (*e*) by annual congresses of manufacturers and trade interests.

If research should show that new industries can be established in this country with advantage, of which I cannot entertain the slightest doubt, it will be possible, by legislation if necessary, to assist their inception by the establishment of industrial banks which would advance funds for the purpose of financing them in their early stages, provided that the methods to be employed had been sanctioned by a competent authority as mentioned above. In addition to this, protection could be given, for a time at least, by patent laws, which, if unsuitable, could be amended, but this is a shield upon which too much reliance should not be placed.

History has shown that wars in the past have proved a stimulus to industry. There is no valid reason to believe that the present one will prove an exception to that rule, and hence the urgent necessity for the immediate organisation of all our resources, even were that not desirable on other more fundamental grounds. Co-operation is the key, and science, education, commerce, and manufacture must form one organic whole, each contributing its share to the common stock, their united effort for the common weal.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The committee for geography has issued its third annual report, 1915–16. The school remains under the acting directorship of Mr. H. O. Beckit pending the appointment of a successor to the late Dr. A. J. Herbertson. The number of students devoting the whole or a great part of their time to geography during the year was twenty-three, and there was also a number of part-time students. Despite depletion of the staff, the whole work of the school was successfully carried out, thanks to the assistance of past students. Dr. R. N. Rudmose Brown was appointed an examiner in succession to Mr. A. R. Hinks, whose term of office had expired. The eighth biennial vacation course, held last August, was attended by 125 students.

AT a conference of directors of public instruction held at Delhi on January 22 Lord Chelmsford, Viceroy of India, in an address of welcome referred to the paramount importance of education in India. From the *Pioneer Mail* we learn that, speaking of technical training, he said at the present moment, when the Government of India is hoping for a lead from the Industrial Commission in the direction of industrial development, technical training looms large in the educational sphere. The term "technical" should, he urged, be used in its widest and not its narrowest sense—that is to say, the claims of agricultural and commercial education should not be overlooked. "There are," he continued, "some who say we have nothing to teach the men on the land in this country. I cannot claim to talk with authority on such a question, but having seen something of the work of scientific agriculture in other parts of the world, I take leave to doubt such a statement. The great advance made by scientific agriculture during the last half-century justifies us in pressing forward with a policy of agricultural education, and though you would not claim to speak as experts on the agricultural side, your educational experience qualifies you to give us useful hints with regard to an advance along this road." Referring to the commercial side of education, the Viceroy expressed surprise to find how little has been done, in spite of India's large and growing commerce, to develop commercial education. Compared with a technical institution, a commercial school is, he said, a relatively cheap institution, and one would think that there was a great opening in big towns for good commercial schools. The second point on which Lord Chelmsford laid emphasis is that in technical training in its narrower sense we must not lose sight of workshop practice in outside works. Laboratory training, however good, is no real substitute for the discipline of the workshop. Technical training divorced from workshop experience is likely to prove a snare and a delusion.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 22.—Sir J. J. Thomson, president, in the chair.—S. A. **Smith**: The fossil human skull found at Talgai, Queensland. This is a description of the fossil human skull that was shown by Profs. Edgeworth David and J. T. Wilson at the meeting in Sydney of the British Association. Before the specimen could be studied it was necessary to clear away a hard mineral incrustation of carbonate of lime which was coloured with iron salts. It was then found to be the highly fossilised and much fractured skull of a male youth not more—probably some years less—than sixteen years of age. The brain-case, the capacity of which was at least 1300 c.c., is well within the range of variation of modern aboriginal Australian skulls, to which it presents a very striking similarity in general conformation, as well as in respect of the distinctively Australian characteristics. But the facial skeleton reveals an important contrast. The exceptionally large teeth—the canines

especially—have been responsible for a great development of that portion of the alveolar process which lodges the incisor, canine, and premolar teeth. In respect of this feature the Talgai skull is probably more primitive and ape-like than that of any other known specimen belonging to the human family, excepting only the Piltdown skull, the dental arcade of which that of the Talgai skull, in spite of its immaturity, nearly approaches, not only in actual size, but also in its relative proportions. The fact that the brain-case had already reached the stage represented in the modern Australian aboriginal, while the face still retained much of the grossness and uncouthness of the ape's, is a further confirmation of the view that, in the evolution of man, the brain first acquired the human status and the refinement of the features came afterwards.—Dr. C. **Chree**: The magnetic storm of August 22, 1916. The paper gives an account of a magnetic storm, accompanied by aurora in Scotland, which occurred on August 22–23, 1916. A comparison is made of the results derived from the magnetic curves at Kew and Eskdalemuir Observatories. The disturbance was much larger at the latter station than at the former. During, however, the most disturbed period, both places afforded a conspicuous example of the type of storm in which the direction of the disturbance vector shows a rapid rotation. During this period the disturbance vector diagram in the horizontal plane was described continuously in a counter-clockwise direction, nearly a complete revolution being effected in the course of one hour.—Prof. W. H. **Young**: The ordinary convergence of restricted Fourier series.

Optical Society, February 8.—J. W. **French**: More notes on glass grinding and polishing. Glass is abraded by splintering, and the efficiency of an abrasive is determined by the form of the grains, their hardness, and their cleavage. A grain that cleaves and presents flat surfaces loses its cut, whereas one that retains its original form when broken suffers only a temporary loss of cut during the grinding process. When precautions are taken to prevent clogging of the abrasive, the amount of glass removed is directly proportional to the relative speed of the grinding tool and the glass. In lubrication too much water has the same bad effect as too little water. A new method was described of comparing the qualities of ground glass surfaces. Polishing was divided into wet polishing, in which material is principally removed, and dry polishing, in which the surface sleeks are filled or closed. A mechanical theory of polishing was elaborated. Rouge consists of grains of ultra-microscopic size. These grains appear to gather, snowball fashion, into lumps of about two wave-lengths diameter, and in this condition they plough grooves in the surface layer. During the second stage these grooves are closed up, thus improving the brilliancy of the surface. When a rounded point is drawn heavily over the surface, a series of semicircular cracks is produced. The cracking takes place on the tension side, and not on the pressure side; the cohesion of the surface layer is less than that of the underlying material. The diameters of the cracks produced have a definite relationship to the pressure. With the semicircular cracks there are associated two series of tangential cracks. Fire-glazed surfaces and fracture-glazed surfaces give similar results; also polished quartz; but the natural polished surfaces of crystals resulting from crystal growth do not exhibit sleeks or surface cracks, thus suggesting the non-existence of a surface layer.

Linnean Society, February 15.—Sir David Prain, president, in the chair.—J. H. **Owen**: The home-life of the sparrow-hawk (*Accipiter nisus*, Linn., Pall.). After a brief description of the life of the birds from autumn to spring, an account was given of the nesting habits, from the selection of the nesting site in March to the scattering of the young at the end of July or in the early part of August. A series of lantern-slides was exhibited to illustrate various features of the nesting habits and growth of the young. Of these, particular interest attached to a series showing the various methods of brooding in wet weather and the care taken over the welfare of the youngest nestling. Another series showed the young able to feed themselves, while the hen keeps watch above the nest during the course of the meal until the young are all asleep after the food is finished. Slides were shown of the visits of young and the old birds to the nest after the young had left.

Royal Microscopical Society, February 21.—Mr. E. Heron-Allen, president, in the chair.—Drs. A. H. **Drew** and Una **Griffin**: The parasitology of *Pyorrhoea alveolaris*. The authors stated that careful microscopic examination of material from cases of pyorrhœa showed that, in the great majority of cases, at least two species of Amœbæ were present. One of these Amœbæ appeared to be a semi-parasite partially modified by anaerobic life in the pockets around the teeth. When stained by the iron-hæmatoxylin method, this form showed a valkamfia type of nucleus; it also possessed a flagellate phase in its life-cycle. The name *Amoeba buccalis* was proposed for this type, which had been successfully cultivated, after concentration of the cysts by Dr. Cropper's method. The other species was a true Entamœba, and corresponded to *Entamoeba gingivalis*. Two new flagellates had been found in the pockets, together with at least six species of spirochætes.

Mathematical Society, March 1.—Mr. G. H. Hardy, vice-president, in the chair.—A. E. **Jolliffe**: Some properties of a quadrangle formed by the points of contact of the tangents drawn to a nodal cubic from any point.—E. H. **Neville**: Indicatrices of curvature.

Paris.

Academy of Sciences, January 15.—M. d'Arsonval in the chair.—G. **Bigourdan**: The first scientific societies of Paris in the seventeenth century.—E. **Ariès**: The law of molecular entropy of fluids taken at corresponding states. The application of the equation of state deduced in an earlier paper.—W. **Kilian** and J. **Révil**: The history of the Arc valley at the Pleistocene period.—A. **Khintchine**: Asymptotic differentiation.—H. **Arctowski**: The heliographic positions of the sun-spots and magnetic storms. After a historical summary of the previous work on this subject the author especially examines the hypotheses of Veeder, Ricco, and Terby. Using data for magnetic storms from observations made at Porto Rico and Greenwich, and Greenwich figures for sun-spot areas, the conclusion is drawn that Veeder's hypothesis is completely out of accord with the observed facts. Terby's hypothesis is equally faulty, but the views of Ricco are partially verified.—J. **Deprat**: The Ordovician and Gothlandian in the north of Tonkin and the basin of the upper Iou-Kiang.—M. **Raclot**: The origin of terrestrial magnetism. Assuming that the internal mass of the earth consists of an alloy in which iron predominates, then, on account of the high temperature, the iron under the continents would be above the critical point at which magnetic properties disappear (750° C. to 900° C.). Under the oceans, on the contrary, by reason of the more rapid cooling assumed by Faye, the superficial layer could have arrived at a temperature below 750° C., and, in consequence, a certain thickness of this could be magnetic. Wulde has shown that if a globe is covered

with thin sheets of iron covering the ocean areas, then the distribution of magnetism on this globe reproduces terrestrial magnetism.—L. **Bordas**: Biological and anatomical observations on some Cetononæ.—H. **Vincent**: The prophylaxy of the infection of wounds received at the front. Comparative study of some antiseptic agents. Trials have been made of sodium fluoride, sodium formate, zinc chloride, calcium hypochlorite, boric acid, borax, copper sulphate, ferrous sulphate, potassium permanganate, and, as an accessory, iodoform. The iodoform, borax, and boric acid were applied in powder; the remainder also in powdered form, but diluted with 90 per cent. of inert powder. Iodoform, ferrous sulphate, boric acid, borax, potassium permanganate, formate of soda, and zinc chloride proved to have insufficient bactericidal power. Sulphate of copper and sodium fluoride have strong antiseptic properties, but are too toxic. A mixture of calcium hypochlorite (10 parts) and dry powdered boric acid (90 parts) is finally recommended for first-aid treatment. It possesses the necessary bactericidal power, gives no pain, and is hæmostatic on account of the calcium chloride it contains. Details of the results obtained by the use of this powder will be given later.—L. **Rompant**: The preservation of eggs.

BOOKS RECEIVED.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-third annual issue. Pp. vi+336. (London: C. Griffin and Co., Ltd.) 7s. 6d. net.

Minor Surgery and Bandaging (Heath-Pollard) for the Use of House Surgeons, Dressers, and Junior Practitioners. By Dr. H. M. Davies. Sixteenth edition. Pp. x+476. (London: J. and A. Churchill.) 8s. 6d. net.

Community: A Sociological Study. By Dr. A. M. Maciver. Pp. xv+437. (London: Macmillan and Co., Ltd.) 12s. net.

Fundamental Conceptions of Modern Mathematics. Variables and Quantities, with a Discussion of the General Conception of Functional Relation. By R. P. Richardson and E. H. Landis. Pp. xv+216. (Chicago and London: The Open Court Publishing Co.) 1.25 dollars net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—Some Effects of Growth-promoting Substances (Auximones) on the Growth of *Lemna minor* in Culture Solutions: W. B. Bottomley.—Some Effects of Growth-promoting Substances (Auximones) on the Soil Organisms concerned in the Nitrogen Cycle: Florence A. Mockeridge.

ROYAL INSTITUTION, at 3.—Sponges; a Study in Evolutionary Biology: Prof. A. Dendy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Voltage Regulation of Rotary Converters: G. A. Juhlin.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 5.30.—The Treatment of Wounds in War: Sir Almroth Wright.

MALACOLOGICAL SOCIETY, at 7.—The Genitalia of *Neanthinula aculeata*: Dr. A. E. Boycott.—(1) The Radula of the Genus Cominella; (2) A Colony of *Purpura lapillus*, with Operculum Malformed or Absent; (3) Note on the Adventures of the Genus named Lucena; (4) Note on the Da Costa Plates adapted for Rackett's Edition of Pulteney's Catalogues: B. B. Woodward.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Occultations Observed at Eltham, 1915: M. E. J. Gheury.—Sun-spot Observations made at Rostow-on-Don: G. D. Tscherny.—(1) The Viscosity of the Earth. III.; (2) Two Applications of Jacobi's Integral: The Moulton-Gylden Theory of the Gegenschein, and Orbital Motion in a Resisting Medium. H. Jeffreys.—The Number of Stars of Different Magnitudes in the Hyderabad Astrographic Catalogue, Zone—17°: R. J. Pocock.—The Surface Currents of Jupiter during the Apparition of 1916–17: G. Bolton.—Preliminary Values of the Variations of Latitude at Greenwich for 1916 Royal Observatory, Greenwich.—(1) Differential Star Corrections; (2) Wireless Time Signals; Some Suggested Improvements: W. E. Cooke.—Frederick de Houtman's Catalogue of Southern Stars, and the Origin of the Southern Constellations: E. B. Knobel.—*Probable Paper*: The Opportunities Afforded by the Eclipse of 1919, May 28, for Verifying Einstein's Theory of Gravitation: Sir F. W. Dyson.

PHYSICAL SOCIETY, at 5.—To Measure the Pressure in a High Vacuum by Means of Logarithmic Decrement: Dr. P. E. Shaw.—(1) A Diffraction Colour Box; (2) Demonstration of Interference Effects with a Thorpe Grating: A. W. Clayden.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Imperial Eugenics; Saving the Soldier: Dr. C. W. Saleeby.

MONDAY, MARCH 12.

ROYAL SOCIETY OF ARTS, at 4.30.—Memorials and Monuments: L. Weaver.

TUESDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Geological War Problems: Prof. J. W. Gregory.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 2 (Joint Meeting with the Prehistoric Society of East Anglia).—Presidential Address: Dr. A. E. Peake.—Plateau Deposits and Implements: R. A. Smith.—The Position of Prehistoric Research in England: J. Reid Moir. At 5.30.—Some Prehistoric Questions: The President.—The Menhirs of Madagascar: A. L. Lewis.

WEDNESDAY, MARCH 14.

ROYAL SOCIETY OF ARTS, at 4.30.—The Supply of Fertilisers during the War: Dr. J. A. Voelcker.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Initial Wave Resistance of a Moving Surface Pressure: Prof. T. H. Havelock.—Experiments with Mercury Jets. (1) The Relation between the Jet-length and the Velocity of Efflux; (2) A Comparison with Jets of Other Liquids: Prof. S. W. J. Smith and H. Moss.—The Mode of Approach to Zero of the Coefficients of a Fourier Series: Prof. W. H. Young.—The Dissipation of Energy in the Tides in Connection with the Acceleration of the Moon's Mean Motion: R. O. Street.

ROYAL INSTITUTION, at 3.—Sponges: a Study in Evolutionary Biology: Prof. A. Dendy.

ROYAL SOCIETY OF ARTS, at 4.30.—The Industrial and Economic Development of Indian Forest Products: R. S. Pearson.

FRIDAY, MARCH 16.

ROYAL INSTITUTION, at 5.30.—Scientific Forestry for the United Kingdom: Sir J. Stirling Maxwell.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Heat Treatment of Large Forgings: Sir W. Beardmore, Bart.—Heat Treatment of Steel Forgings: H. H. Ashdown.

SATURDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—Imperial Eugenics: Saving the Future: Dr. C. W. Saleeby.

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THURSDAY, MARCH 15, 1917.

HUNGER AND APPETITE.

(1) *The Control of Hunger in Health and Disease.* By Anton Julius Carlson. Pp. vii + 319. (Chicago: University of Chicago Press; Cambridge: At the University Press, 1916.) Price 9*s.* net.

(2) *Food and Health: An Elementary Text-book of Home Making.* By Prof. Helen Kinne and Anna M. Cooley. Pp. vi + 312. (The Home-Making Series.) (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 3*s.* net.

(1) PROF. CARLSON gives, in this volume, a general account of the work done, chiefly in his laboratory, on the physiology of hunger and some related questions. He was fortunate to have as subject of experiment a man who possessed a gastric fistula, made in consequence of an œsophageal stricture when he was a boy. Experiments were also made on Prof. Carlson himself and other normal subjects, as well as on dogs and lower animals.

The net result of the investigation is to show that the sensation of hunger is due to a periodic series of rhythmic contractions, which take place in the stomach when empty. Haller had suggested this cause, but thought that the sensation was produced by the rubbing together of folds of the mucous membrane. Prof. Carlson shows that the sensation has its origin in receptors in the muscle substance itself. The contractions are started in the stomach, although their rhythm is slightly altered after the stomach is separated from the central nervous system. When food is taken the hunger contractions cease for a few minutes, and then the movements of digestion begin. These differ from the hunger contractions, being primarily concerned with the pyloric end, whereas the latter are initiated at the cardiac end and pass as peristaltic waves over the whole stomach. It would seem that the only satisfactory explanation of the digestion contractions is that they are brought about by the central nervous system, the hunger contractions being inhibited for the purpose. This inhibition can be produced by sensations of taste, or by the presence in the stomach of water, gastric juice, acid, alkali, oil, and other things, or in the intestine of gastric juice, acid, or alkali. It is interesting to note that alcohol inhibits hunger, while it may increase appetite. Appetite, in fact, is quite different from hunger, being rather a mental anticipation of pleasant sensations to come. It is, however, more complex than this, as the discussion in Prof. Carlson's book shows. We know that appetite may be present without hunger, and the experience of fasting men is that hunger may be present without appetite.

The nerves that convey the afferent impulses produced by the hunger contractions are the vagi. As already stated, these contractions are not set into action by any stimuli from the outside, although they can be thus inhibited. The channels of inhibition appear to be chiefly through the splanchnic nerves, but central inhibition of the tone of the vagus centre also plays a part. We find, therefore, a further case of reciprocal innervation of the kind described by the reviewer in vaso-motor reflexes.

Various other questions are elucidated incidentally. The sensibility of the gastric mucous membrane to heat and cold is shown to be a true one, and Head's statement as to its protopathic nature is confirmed.

The want of food, even in protozoa and plants, is manifested by increased excitability and restlessness. In animals this state induces them to take food, because they have learned that food abolishes the feeling.

The book concludes with observations on the secretion and the chemical properties of human gastric juice, and with the discussion of hunger and appetite in disease. As a practical general conclusion we may note that the physiological way of increasing hunger and appetite is moderation in the amount of food taken, or increasing the utilisation of food by outdoor living, fresh air, cold baths, and muscular exercise.

The book is a very valuable and interesting account of a somewhat neglected branch of physiology.

(2) This manual is of a different nature. Although intended primarily for use in schools, it contains a mass of useful information for all concerned with occupations in the home. It is chiefly concerned with the preparation of food, but includes instructions for its preservation, and also for the raising and selling of poultry and so on. The making and properties of bread are described in considerable detail.

The physiological facts are correctly given, and the explanation of the energy value of food and the unit in which it is expressed, the Calorie, is particularly well done. There are, however, one or two surprising omissions. No reference is made to the "accessory factors" of food, or to the misuse of alcohol, although we have a warning against the far less serious misuse of tea and coffee. Perhaps the alcohol question is not so pressing in the United States as with us.

Both books are well provided with illustrations, and contain indexes and references to literature for those who wish to follow up the subject in more detail. Many otherwise excellent works lose much of their value owing to the absence of one or other of these indispensable components.

W. M. BAYLISS.

THEORETICAL AND PRACTICAL PHYSICS.

(1) *A Text-book of Physics.* Edited by A. Wilmer Duff. Fourth edition, revised. Pp. xiv + 692. (London: J. and A. Churchill, 1916.) Price 10*s.* 6*d.* net.

(2) *Practical Experiments in Heat.* Pp. viii + 123.

(3) *Practical Experiments in Light.* Pp. viii+112. By W. St. B. Griffith and P. T. Petrie. (London: Rivingtons, 1916.) Price 3*s.* 6*d.* net.

(1) THE fourth edition of the "Text-book of Physics" edited by Prof. A. Wilmer Duff shows numerous changes, especially in the paragraphs dealing with the dynamics of rotation. A new part on sound has been prepared, in which recent important work is described, including the researches of Prof. Miller by means of his "phonodeik" and the experiments of Prof. Sabine on architectural acoustics. A careful study of the results obtained by the latter investigator has shown that attempts to reduce reverberation by stretching fine wires across a hall or by similar devices are entirely useless. Other sections of this excellent treatise have also been brought up to date; we notice an interesting account of Dr. Langmuir's mercury-vapour pump, which is given high praise: "Because of its remarkable simplicity and rapidity of action, it marks a great advance in methods of obtaining high vacua." The only criticism of the volume we have to make is that some of the illustrations (*e.g.* the tangent galvanometer, p. 384) are scarcely worthy of the text.

(2) and (3) The authors of these text-books on practical physics are masters at Uppingham School, and they have found, as have other teachers, that a laboratory guide, either written or printed, is requisite for the efficient teaching of large classes. There are drawbacks to every method of instruction; some students are met with who, from mental inertia or defective elementary education, seem incapable of following the description of an experiment given in print, whilst they can understand an oral account. Others, again, slavishly follow the printed page, and will even copy the diagram in their text-book instead of sketching the actual apparatus used. In such cases it is, perhaps, unfortunate that all the quantitative experiments should be illustrated by worked-out numerical examples. The books under discussion are intended "for the use of boys between the ages of thirteen and twenty." Their chief recommendation is the large number of simple experiments which can be carried out without the use of elaborate apparatus. Graphical methods are rightly emphasised, and a word of praise must be given to the clearly drawn graphs reproduced in the text. Some of the other diagrams in "Heat" are not quite so satisfactory.

The directions given are, as a rule, lucid and exact, but occasionally we find a misleading or careless sentence—*e.g.* "Do not touch the calorimeter and use the thermometer as a stirrer" (p. 50); "The temperature of different Bunsen flames vary considerably" (p. 71). The authors do not appear to realise that convection plays a more important part than radiation in the cooling of a hot body. In the chapter on calorimetry (one of the best in "Heat") the calorimeter, "bright on the outside," should not be exposed on the bench, but be supported in an outer metal vessel or be wrapped with cotton-wool and put in a beaker. The account of Newton's law of cooling is defective for the same reason. It is to be regretted that in the experiment on Boyle's law the results are tabulated with six significant figures, though the observations contain only three figures. The authors have not even the excuse of Biot, who, when his attention was drawn to a similar case, replied sarcastically that if the first figures were wrong, perhaps the last would be right. In Regnault's hygrometer the end of the boiling tube must be cut off before the metal thimble is cemented to it. There are in all fifty-nine experiments in "Heat" and sixty-eight in "Light." The experiments in "Light" are of the type now familiar, pin methods being employed frequently. In the first experiment, which purports to show that light travels in straight lines, it is necessary to prove that the hat-pin (used to test the alignment of the holes in the three card-board screens) is straight. As an optical method is inadmissible, this might be done by fixing two of the screens, rotating the hat-pin, and noticing whether there is any lateral displacement of the third screen. The questions addressed to the student form a valuable feature in connection with the earlier part of the Light course. H. S. A.

THE TECHNOLOGY OF TYPOGRAPHICAL PRINTING SURFACES.

Typographical Printing-surfaces: the Technology and Mechanism of their Production. By L. A. Legros and J. C. Grant. Pp. xxiv+732. (London: Longmans, Green and Co., 1916.) Price 2*l.* 2*s.* net.

THIS work is the outcome of a paper read by one of the authors before the Institution of Mechanical Engineers a few years ago: the paper created at the time some amount of interest in the printing world owing to the thoroughness with which it had been prepared. That matter has now been considerably enlarged—perhaps too much so in some instances—but we must readily admit the usefulness of the bulk of the information collected together, because of its previously being scattered abroad in many directions, and due credit must be given to the compilers for the great labour involved in bringing together so much valuable material; certainly as a work of reference on its subject the book will be found most useful.

The volume is jointly dedicated to our first authority on printing, Joseph Moxon, 1627–1700, and to the French writer, Simon Fourrier, another great authority, 1712–68, and is a stupendous work of its kind. As it professes, it covers a good deal of the ground which hitherto has been but scantily treated, so far as type-founding is concerned, in any English text-book on printing ever published. In fact, Moxon, in his "Mechanick Exercises," 1683, is the only writer

who has attempted to deal with this subject to any extent. Naturally, at that period Moxon treated of typefounding by the hand method of casting, but in the large work now under notice the founding of even single letters is shown to be produced by many machines of various kinds. Hand-casting is rarely used nowadays, except for the occasional casting of small orders or for special purposes. Further, in adopting mechanical means many of the preliminary and finishing stages needful in the old hand method are now dispensed with.

Even as hand-press work is not to be compared with the output of the power-press, so it is with typefounding—thousands of letters are now turned out in the place of a single hundred, and the comparison is even greater when the rotary system of casting is employed.

As its title implies, the work is confined to the production of typographical surfaces of all kinds, and this covers a very wide range indeed. It includes not only hand-set types and those composed by different machines, but engraved blocks, reproductions by the stereotype and electrotype methods, process blocks, and all other surfaces in relief. The details of designing type faces—a most important matter if a good fount is desired—punch cutting, and the making of the matrices and moulds for the final stage of casting, are all admirably described, particularly so from both the draughtsman's and the engineer's point of view. Besides very full and concise descriptions of the various casting machines in use at the present time, the different systems of type-composing machines from their first conception up to recent date have several chapters devoted to long and technical descriptions.

In addition to several useful appendices, much other information of a general character is given —most interesting to those practising, or who are students of, the art of printing—which stamps the volume as a valuable work of reference.

The numerous diagrams have been very carefully drawn, and the reproductions of other illustrations are equally well rendered. These, with a number of useful tables, a technical vocabulary in three languages, and a very full index, complete a work which must create a demand for its possession.

The authors are deserving of praise for the careful labour they have bestowed on the compilation of this bulky and useful volume. It certainly must be a great revelation to non-technical readers, who can have but a faint idea of the vast amount of detail underlying the fundamental stage of preparing typographical surfaces for the printing press, the greater portion of which only developed during the closing years of the nineteenth century. It all helps to prove how necessary a scientific training is for the technical education of our future craftsmen.

The typographical production of the book itself must have been a great tax on the resources of the printers responsible, and they are to be congratulated on the result.

IS VARIATION A REALITY?

Evolution by Means of Hybridisation. By J. P. Lotsy. Pp. viii + 166. (The Hague: Martinus Nijhoff, 1916.) Price 6s. net.

DR. LOTSY'S book is one of many signs that biologists are growing uneasy about the adequacy of evolutionary theory. By whatever doubts the doctrine of Selection was assailed, it has hitherto been common ground that in their generations the forms of life varied abundantly, and that somehow through these variations the diversity of species had come to pass. Modern genetic research has led to the paradoxical discovery that much of the best evidence of variability is capable of other interpretations. Consider the "variation" of any polymorphic moth. No one doubted that from any of the varieties any other might be bred. Now we see that was a mistake. Such variation is not promiscuous, and the varieties are really an orderly series consisting of distinct types which will breed as true as any species, and of mongrel forms which can throw certain fixed types, and those only. The Mendelian conception of the homozygote has raised a new problem. The question arises: Can the offspring of homozygotes vary? Dr. Lotsy is sure they cannot. New forms can only come by crossing. That is the thesis of this book. "*Crossing, therefore, is the cause of the origin of new types; heredity perpetuates them; selection is the cause,* not of their origin, as was formerly supposed, *but of their extinction.*"

This is a bold pronouncement, and it contains much of truth. We think not merely of the many species suspected of hybrid origin, but comprehensively of the innumerable species, now perfectly distinct, which can quite reasonably be thought of as segregates derived from some cross ages ago. Few also now believe that the domesticated forms comprising many breeds really had single origins. Apart from difficulties introduced by exact genetic knowledge, modern writers have felt driven to suggest "polyphyletic" origins for pigeons, fowls, dogs, cereals, the common fruits, etc. Almost whenever the history of a modern breed is known it can be traced to a cross. Dr. Lotsy took over a wonderful F_2 from a cross in Antirrhinum made by Prof. Baur, and, as he rightly says, it contained many types capable of perpetuation as incontrovertible species. Most geneticists have seen such series and been tempted to similar conjectures. But Dr. Lotsy is for taking still wider flights. Geology shows, he says, that new classes appear suddenly with many highly differentiated forms—the Cycads, for instance, of Mesozoic times. May not they be the direct consequence of some cross? Perhaps; but whence came the original diversity? Why were there distinct forms ready to be crossed? We find no answer to that fundamental question. In the view of the present writer, too, the doctrine of invariability of the homozygote cannot be maintained. Variability is rarer than we supposed, but it is a genuine phenomenon witnessed in unimpeachable examples.

The book will do good if it rouses any reader from the torpor of an easy orthodoxy. It may excite doubts, if it cannot allay them. The language and printing of the book make it something of a curiosity. Cosmopolitanism is a virtue we are glad to meet in these days. Still, English *à la Hollandaise* is a sore distraction in a serious book. W. BATESON.

OUR BOOKSHELF.

The Biology of Tumours. By C. Mansell Moullin. Pp. 55. (London: H. K. Lewis and Co., Ltd., 1916.) Price 2*s*. 6*d*. net.

THIS book comprises the Bradshaw Lecture, somewhat extended, delivered by Mr. Mansell Moullin before the Royal College of Surgeons in 1912. The author admits that the conclusions he has arrived at differ in many particulars from the views that are generally current; nevertheless, his suggestions are stimulating, and in the present state of our knowledge of the causation of tumours it cannot be said that they are erroneous. Mr. Moullin divides tumours by their mode of origin into two classes: one due to the sudden awakening of the innate reproductive power of the tissues, in virtue of which they give birth to "buds" that grow into tumours; the other due to details of structure not being carried out so completely as they ought to be. The distinguishing feature of the former class of tumours is their independence: they grow quite irrespective of the tissue in which they develop. This group includes the vast majority of tumours, innocent and malignant. Development is the influence which restrains the potentiality possessed by the cells of the tissues to multiply indefinitely, and is due to chemical influences. All that is needed, then, for tumour formation is some exciting cause, mechanical or chemical, to give the growth a start. Thus, multiple tumours of the skin may develop from the prolonged administration of arsenic, tumours of the bladder are relatively common in workers in fuchsin, and cancer of the skin often follows the continued application of soot, tar, and paraffin.

We believe we have stated the author's views correctly, though they are somewhat difficult to follow, and it would have been useful had he given a brief summary at the end of the book. In some respects the hypothesis is similar to that of Ross, who regards certain chemical substances—"auxetics," as he terms them—as capable of inducing cellular proliferation.

Atoms. By Prof. Jean Perrin. Authorised translation by D. Ll. Hammick. Pp. xv+211. (London: Constable and Co., Ltd., 1916.) Price 6*s*. net.

THE appearance of the authorised translation of Prof. Perrin's book, "Les Atomes," is very welcome. It is true that the demand for translations into English of ordinary French scientific works is not great, but books of the semi-popular kind such as the one under review are in a rather different category. A student with only a moderate knowledge of French may read with advantage a standard French treatise, but he would be apt to miss the point of many of the illuminating illustrations and analogies with which Prof. Perrin's work abounds.

Mr. Hammick is to be congratulated upon the excellence of his translation. Without previous knowledge, one would scarcely suspect that the book is a translation at all—it reads as though it had been written in English in the first instance. And yet, upon comparison with the original, it is found that the translator has adhered remarkably closely to the text. A few small errors have survived revision—for example, the use of *definitely* for *definite* on p. x, line 26, and *which* for *who* on p. 207, line 37.

The original French edition has been already reviewed. In the present translation there is an additional paragraph dealing with Mr. C. T. R. Wilson's beautiful photographs of the paths of α and β particles. The book is well bound and printed, and is unhesitatingly recommended both to those who will appreciate a popular exposition of the subject, and to those to whom it is of interest to survey the modern methods and results in widely differing fields of research converging towards the same end.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Thermodynamics and Gravitation.

THE Carnot cycle in Dr. G. W. Todd's interesting letter (NATURE, March 1, p. 5) leads by a ready extension to the result that if the force of gravitation on a body depended on its temperature, and thermodynamics were applicable, there must be interaction between the gravitational field sustained by a body and its thermal molecular energy; so that part of the exhaustion of energy of position when the field does work on the body would go to increase its store of heat, only the remainder appearing as work done. Thus when, owing to displacement of a body of mass m in the field of force, work δW is done *against* the field, so that energy δW is gained, then also heat must be gained by the body of amount $-\frac{T}{m}\frac{d}{dT}\delta W$, if its temperature is not to change. There would be dissipation of energy involved in the diffusion of such heat, just as in the case of heat of compression in sound-waves of very slow period. Only in two ideal limiting cases will there be conservation, and then δW will be the increment, arising from the displacement alone, of a function of position and also temperature, which thus constitutes a gravitational potential W: in these cases the heat of the body will depend definitely on its temperature T and its position in the field of force, the latter contributing an amount constant $\frac{T}{m}\frac{dW}{dT}$. These two cases, of some curious theoretical interest, are: (i) that of a universe isolated in an enclosure maintained isothermal by internal radia-

tion; (ii) that of an adiabatic universe in which there is no exchange of heat by radiation or contact.

Reverting to the formula: if the gravitation exerted on m increased by the fraction $1/k$ of itself for a rise of 1° C. in temperature, then at temperature 0° C. a change of gravitational energy into work would be accompanied, on Carnot's principle, by a gain of thermal energy equal to $273/k$ of its amount, which could scarcely escape notice unless k were large.

The sign in Dr. Todd's relation (1) seems to require change. An objection applies to his hypothesis (2) that it leads him to a temperature term in the law of force which has the same value at all distances.

Cambridge, March 4. J. L.

THE interesting letter from Dr. G. W. Todd in NATURE of March 1 opens new ground on the subject of gravitation and temperature. But does not the expression found need some modifications? Thus, in the general case with m at temperature θ and M at temperature Θ, we might write for the force the expression

$$F = G\frac{Mm}{r^2} + A(M \log \Theta + m \log \theta).$$

But even when thus generalised, the formula still seems unsatisfactory. Has Dr. Todd considered how to deal with the following curious facts?—(1) The temperature corrections vanish at *unit* temperature; (2) at the temperature of absolute *zero* the attractive force becomes *minus infinity*, *i.e.* an *infinite repulsion*! (3) the temperature correction is given as independent of r, the distance apart of the masses. Hence

$$\frac{\text{temperature correction to force}}{\text{force itself}} \propto r^2.$$

Thus, for large values of r, the temperature correction to the force might exceed the Newtonian value of the force itself. E. H. BARTON.

University College, Nottingham, March 8.

Floating Earths.

WILL any of your readers kindly help in elucidating a passage of Strabo? It occurs in his Book XIII., i., 67. The Greek is fairly plain, so a translation will suffice:—

"It is said that at Pitane the bricks float on water, which has occurred also in the case of an islet in Tyrrhenia; for the earth is lighter than an equivalent bulk of water, so that it rides on the surface. Posidonius also says that he saw in Iberia a certain argillaceous earth, used for taking moulds of silver work, from which bricks were made which floated."

The site of Pitane is the modern Chandarli, or Sandarli, a small harbour on the west coast of Asia Minor, about 30 miles north of Smyrna and 15 miles south-west of Bergama (Pergamon). Tyrrhenia is, of course, Tuscany. Iberia is, no doubt, in this case Spain. The name is also used for a district in the Caucasus practically identical with the modern Georgia; but without qualification it should mean Spain; and Strabo elsewhere quotes Posidonius as an authority on natural phenomena in that country

The two "earths" which occur to me as floating on water are pumice and meerschaum. Meerschaum is, of course, found in Asia Minor; Eski Shehr is the principal source. But that is a long way from the west coast, and I can find no record of its occurrence anywhere near Pitane. In any case, it does not seem likely that it should have been used for building purposes; and the use of the definite article, "the" bricks (τὰς πλίνθους), seems to imply that the substance in question was the ordinary building material of the district.

Pitane lay on the south side of the Kara-dagh, a large mass of eruptive rocks, andesite overlying tuffs, as I learn from Philippson, who has described the formation (*Reisen u. Forsch. im westl. Kleinasien*, Petermann's Mitth., suppl. 167 (1910), p. 95). It would seem, then, that in the case of Pitane the material must have been tuff. Is it possible that a tuff porous enough to float on water could be used as a building material, or that passably durable "bricks" could be made of it?

The floating "islet" in Tuscany may, I suppose, have been a mass of pumice from the Lipari Islands drifting northwards. Such islets are recorded to have floated about the Ægean Sea after the great eruption of Santorin in 1650, and even to have blocked some of the ports. But though the Lipari Islands contain enormous masses of pumice light enough to float, I can find no record of any having been actually ejected into the sea in historical times. Can anyone tell me if there is such a record?

The "argillaceous earth" in Spain clearly cannot have been tuff or pumice. Can it have been meerschaum? This material is, of course, capable of delicate carving; would it be suitable for making moulds for copying silver work? It is said that there are limited deposits of it in Spain. It may be noticed that the quotation from Posidonius does not imply that it was actually used for building, but says only that bricks "formed" (πηγνυμένας) from it will float. This may mean no more than that blocks of the shape and size of a brick will float. I am not clear as to the exact meaning of πηγνυμένας—whether it implies any process more than mere cutting. One would naturally expect it to mean "congealed" or "solidified." Meerschaum is, I understand, soft when dug, but hardens on exposure to the air. Perhaps, therefore, the word may mean "hardened." On the other hand, I feel confident that in the phrase ᾗ τὰ ἀργυρώματα ἐκμάττεται the verb is used in the technical sense of taking a mould or impression, not, as some have thought, with the trivial meaning, "with which silver work is cleaned."

Anyone who can enlighten an ignorant Hellenist on these points would be assured of his gratitude.

WALTER LEAF.

6 Sussex Place, Regent's Park, N.W., February 24.

SCIENTIFIC ASPECTS OF FUEL ECONOMY.[1]

THE appointment of a Board of Fuel Research by the Committee of the Privy Council for Scientific and Industrial Research on the recommendation of the Advisory Council was noted in NATURE of February 22, and something may perhaps be said with advantage on the real and pressing need for securing, so far as it may be done by official efforts, the fullest investigation of the potentialities of fuel.

To those occupied with the study of the scientific utilisation of coal, the crude and wasteful way in which we, as a nation, have been maltreating our supplies of that irreplaceable raw material has been for some time past a depressing spectacle. Recognition of the value of purely thermal economies has been fairly general, although the quantities of fuel used in feeding

[1] Report of the British Association Committee on Fuel Economy, September, 1916.
Memorandum by Chief Engineer, the Manchester Steam Users' Association, for the year 1915.

small steam-engines permit no unqualified statement to that effect; but the less instinctive appreciation of the chemical value latent in coal has been a slow, and is still a stunted, growth. Our recent needs for benzene, toluene, and phenol for the making of high explosives, and the publicity given to the coal-tar dye question, have opened many eyes to the value of carbonisation, apart from its production of coke for our blast furnaces and gas for our towns; but even now the iniquity of the prevalent nitrogen waste passes almost unnoticed. To regard coal always as a source of available heat, tar, and nitrogen is a habit of mind to cultivate; consistent condemnation and eventual elimination of methods of use which offer violent offence to that regard will follow.

The particular directions which reform will take, or ought to take, in the many uses to which coal is put are less obvious than the urgent necessity for reform. Carbonisation, with all its possible variation of methods and results, demands a closer systematic study on the small and large scale, in laboratories suitably equipped and staffed and in the works. Comparison of the results obtained by Wheeler at home and by Pictet abroad with those of ordinary coke-oven or gasworks practice shows the extent to which the nature and quantity of products are dominated by variation in conditions of operation, and emphasises the necessity for a thorough knowledge of the processes involved in the transition from primary to secondary products of carbonisation, with a view to their intelligent control.

The work of Bergius, although of uncertain value on the industrial scale, touches upon another possibility, that of carbonising under very high pressure; if successful, it would demand a new type of plant, somewhat analogous to that employed for the Haber synthetic-ammonia process, and presenting new problems of construction and working. At the other end of the scale stands carbonisation with reduced pressure, already under trial on a scale above that of the laboratory. Less removed from current practice in carbonisation are the low-temperature processes, such as the Del Monte, and the presumably improved form or development of the ill-fated Coalite process, which, it is hoped, will receive an adequate trial at Barugh. Several questions await an answer from such processes. It is conceded that they can produce tar rich in low-boiling-point constituents, but are these constituents to be mainly paraffinoid, as certainly seems probable, or aromatic, with benzene and toluene? The ammonia yield is in question; laboratory experiments indicate that a real beginning is not made in forming ammonia from coal by heating until a temperature of 500° C. is exceeded, and that 700° to 800° C. is necessary for a yield which the standard carbonising practice would call good. Soft coke has undoubted advantages for the open grate, but can it be made for carrying in bulk without crushing? These are some of the simpler issues.

As regards nitrogen, the Mond process, with its 60 to 70 per cent. recovery as ammonia, is satisfactory, but the gasification of coal in an air-steam blast gives of necessity a gas too highly diluted with nitrogen to be of any service for high-temperature operations, excepting in large furnaces where regeneration can be employed. The tar, too, has its peculiarities. Otherwise the process is successful in practice, as it is sound in principle, and all concerned with its initiation are to be doubly congratulated, in the first place on an extremely valuable contribution to the science and practice of fuel utilisation, and in the second on the comparatively advanced stage to which the working-out of the process had been carried before it was declared ready for use.

None of our methods of using fuel can be regarded as attaining the ideal, but the most disturbing factor in the situation is that such advances as we have made are not properly utilised; even to-day the great bulk of our domestic heating is done with raw coal in the open fire, and our great modern power-houses are mainly run with raw coal in their boiler furnaces. The pall of smoke over our cities signalises the daily sacrifice. Then, again, our metallurgical industries, although using gaseous fuel largely in regenerative open-hearth furnaces which do secure thermal economy, still neglect and destroy the chemical value of coal by gasifying without recovery of either tar or ammonia.

The country was never so ready as now to accept the application of a remedy for these evils, but must first feel that before it lies a rational treatment, based on a sane and sober diagnosis, and not on the facile verbalism of ill-considered propaganda. Some few simple prohibitions, automatically progressive in their application, may be found advisable, and, if so reasonable as to be practicable, would probably be effective in checking criminal waste, and at the same time encourage those developments in the technique of fuel utilisation on which we must depend ultimately for success.

There has been wanting sufficient systematic attention to fuel problems from investigators, administrators, and legislators alike. It is true that, owing largely to the initiative and foresight of Prof. Smithells, the University of Leeds (followed more recently by the Imperial College in London) has established a department of fuel technology, and that the gas industry has generously endowed there the Livesey chair in memory of a great leader; but how long has the paramount necessity for what were pioneering ventures a few years ago been recognised, and how very much more remains to be done before it can be claimed that the subject of the scientific utilisation of fuel is receiving anything like adequate study or the same degree of public support as is accorded in America and Germany. Committees are to the fore just now, and the British Association has appointed one, with Prof. Bone as chairman, for the investigation of fuel economy, the utilisation of coal, and smoke prevention; this may be one sign of an awakening. The terms of reference

are wide, which consideration presumably justifies a list of members somewhat disconcerting in its length.

The committee has issued a first report, and if it relates intention rather than achievement, that is only natural at a time when so many of the committee must be very fully occupied with urgent national duties. The field has been mapped out, however, and a number of sub-committees appointed to give special attention to sectional work.

Having regard (says the report) to the magnitude of its work, and the fact that the coal question is one upon which almost every branch of manufacturing and transport industry is dependent, the original committee of thirteen members appointed by the Association in October, 1915, decided to exercise somewhat freely its power of co-option so as to make a general committee sufficiently large and representative of all the important interests involved.

The chemical and statistical sub-committee, with Dr. J. T. Dunn as chairman, is proposing to occupy itself with the chemical investigation of coal, the survey of the chemical character of the principal British coal seams, and an inquiry into the amount of wastage due to coal which for one reason or another is at present left behind in the pits. Another sub-committee, with Mr. T. Y. Greener as chairman, is to deal entirely with carbonisation. A return is to be prepared which, when completed,

will enable the committee to arrive at an approximate estimate of the margins of possible economies in the shape of improved utilisation of the coal carbonised, which can now be effected in the coking industry, and the directions in which further progress is likely to be made. A memorandum is also in course of preparation describing the more important developments of the by-product coking industry, from its inception until the present day.

"The committee would welcome the offer of proper facilities to enable them to investigate the question of low-temperature carbonisation."

Dr. J. E. Stead is chairman of the sub-committee for metallurgical, ceramic, and refractory materials, which is concerning itself mainly with ascertaining actual fuel consumptions in these industries, and

will endeavour to draw up a statement as to the best lay-out and arrangement of a combined by-product coking, iron-smelting, and steel-making plant, from the point of view of utilising as completely as possible surplus gases and waste heat, and thus realising the maximum fuel economy in the heavy steel industry.

A sub-committee on power and steam-raising, with Mr. C. H. Merz as chairman, is to investigate the economies in fuel which would result from the use of improved methods. Regarding the practice of to-day,

in view of the impossibility of obtaining accurate returns of fuel consumption per horse-power-hour from the whole of the power users in this country, it has been decided to investigate the matter by asking for detailed returns from typical factories in various trades and in different districts throughout the country, selected by members of the sub-committee who have special knowledge of particular trades. Special memoranda are in course of preparation on questions of organisation of power production for industrial and transport purposes, the use of large turbine- and gas-engines, and other important aspects of the power question.

Mr. E. D. Simon, secretary of the committee, is also acting as chairman of the domestic fuel sub-committee, which feels

that it will be wise to recognise at the outset that there is probably no single solution of the domestic heating problem which is likely to be universally adopted within any measurable period of time; and that, therefore, it should preferably concentrate its efforts upon questions of more immediate practical importance.

It proposes, therefore, to examine the possibilities of existing systems and methods, and also the relative efficiencies of coal-fired, gas-fired, and electrical heaters.

Arising out of the present extensive use of solid fuel in domestic fires, the sub-committee will also consider the important question of the prospects of substituting for raw coal some form of carbonised fuel (semi-coke or coke). There can be no doubt but that if such a substitution could be effected, without either increasing the domestic coal bill or involving some other disadvantage, not only would there be a great addition to the amount of valuable by-products annually obtained from coal consumed in the Kingdom, but also the smoke nuisance in our large centres of population would be materially reduced.

The scheme of work which the committee and its five sub-committees set out is frankly ambitious and highly comprehensive, and although this first report would be more accurately described as a prospectus, that peculiarity will presumably not attach to future issues.

A memorandum on a special aspect of the fuel question has been issued to the executive committee of the Manchester Steam Users' Association by Mr. C. E. Stromeyer, their chief engineer; it is concerned primarily with steam-raising. The author thinks that "our manufacturers have been spoiled by the ease with which they could obtain the very best coal in the world," and deplores "our almost universal practice of over-working boilers." On the Continent, he points out, first-class coal cannot be obtained, "but there the works provide themselves with ample boiler power, and, on the whole, they obtain a higher efficiency than we can hope for with our superior coal but hard-worked boilers." To use coke and conserve by-products would necessitate the same reform. "Steam users naturally do not like coke, partly on account of its relatively high price, and partly because it would require larger boilers than the present ones in which to burn it with as good effect as the best coal." But Mr. Stromeyer does not expect too much from this source; he considers a number of working results with steam-engines of various types, and concludes:—

The fuel economy question may therefore be briefly summarised by saying that hardly any improvement is likely to be effected in the economic working of boilers, for, as is well known, there is only a margin of about 20 to 25 per cent. to play with. Considerable pecuniary saving might often be effected by increasing the number of boilers, so as to be able to burn a poor and relatively cheap fuel if this can be got. Our chief hopes will therefore have to be centred on engine im-

provements, for here large savings might be possible, because at present about eight units are thrown away for every one doing useful work.

The steam turbine is regarded as combining the greatest number of advantages among the prime movers of to-day, and as an interesting novelty the Lundholm turbine is mentioned, consisting of two discs and blades revolving in opposite directions.

As there is no difference of expansion of the two discs there is every prospect that the clearances of the blades can now be reduced to a minimum, and that this very serious source of loss will be materially reduced.

The possibilities of the gas-engine, and particularly of the internal-combustion turbine, perhaps in the near future, appeal to Mr. Stromeyer and lead to the following:—

From a national economic point of view the combination of the internal-combustion engine with electric distribution of power would seem an ideal one. Our collieries would then be encouraged to mine even our dirtiest coal. This coal would produce by-products for farmers and for the coal-tar industries and supply the engines with suitable gas, and our factories would receive their power at a lower cost than they could produce it.

The general attitude of the author seems to be that of an experienced engineer, convinced that economy in power production is going to be so vital to us after the war that strenuous effort and a bold and encouraging policy as regards both invention and research are primary conditions of our continued commercial progress.

Although in all probability no such effective blight could be laid upon the work of scientific investigation in any field as that of undue centralisation and impossible regimenting, enough has perhaps been said to indicate that the scale of research necessary for adequacy in the domain of fuel necessitates, among other things, liberal financial support, and if the Government is going to provide that support it will naturally seek for guidance. Presumably the new Board of Fuel Research is to guide. Its director is Sir George Beilby, whose varied industrial and scientific experience should prove of the greatest value. Sir Charles Parsons, Mr. Richard Threlfall, and Sir Richard Redmayne will assist him as members of the board, and Prof. W. A. Bone will act as consultant. This form of organisation for research is new to the country and its working will be watched with great interest. There are pitfalls in the way, which it may be difficult to avoid, and would certainly be folly to ignore, but an administration directed with liberality of spirit to really national ends will go a long way to command success.

JOHN W. COBB.

THE SEPTIC PROBLEM IN WAR.

OF all the many varieties of wounds with which surgery has to deal, incised, contused, lacerated, etc., the most dreaded one is the punctured variety. This is because the inflicting weapon is almost necessarily infected with pathogenic organisms, and because these organisms are therefore implanted in the depths of a long and narrow track, into which antiseptics can be made to penetrate only with considerable difficulty.

Of all punctured wounds those produced by gunshots are the most difficult to deal with. The reasons for this become obvious upon consideration. The mere force of impact, in the first place, is an unusual and important feature. The energy in foot-tons of a projectile of known weight and velocity can easily be calculated, and it is to be remembered that this energy is concentrated upon a small area, with the result that the actual track of such a missile in human tissues is a tunnel the walls of which are *dead tissues*.

The importance of this fact in favouring bacterial growth is immense. Moreover, the tunnel is surrounded by a cylinder of tissue of which the constituent elements are bruised and under the influence of local shock, so that their vitality and resisting power to bacterial invasion are reduced. If such a missile strikes hard bone, a high degree of shattering and splintering takes place, while portions of broken bone are driven into the surrounding muscles, sometimes lacerating important vessels and nerves, and even bursting through the skin, and forming a large opening known as an "explosive exit." Owing to the ballistic properties of the pointed bullet, which is now used by all countries, and which tends to turn over on its short axis on impact, the proportion of these severe wounds is somewhat greater than in previous campaigns.

Another difficulty in the case of gunshot injuries is their special liability to severe forms of septic infection in the circumstances of the present campaign. In South Africa military surgeons found that a large number of wounds, even when bone was involved, showed small wounds of entrance and exit, and, so far as infection was concerned, merely required cleaning and sealing to heal without trouble. This was in part due to the shape of the bullet and its tendency to traverse the tissues by a straight course without turning on its short axis. This meant small external openings, and therefore less liability to infection from them. But the chief cause of the immunity from infection was the comparative dryness of the country, and a soil for the most part uncontaminated by human occupation or cultivation.

The conditions in the European area of the present conflict are very different. The humidity of the climate is greatly in excess of that of South Africa, and intensive cultivation means copious manuring of the soil, so that most of the ground occupied by our troops is thoroughly sown with bacteria of fæcal origin, which include, besides those ordinarily called pyogenic or pus-producing, the special germs of tetanus, malignant œdema, and gas gangrene. It is in ground thus infected that our soldiers sleep, take their food, and are occasionally buried alive. Their skin and clothes are plentifully smeared with bacterial mud, and it is no matter for surprise that when a bullet passes into their bodies

it carries with it, and implants in all the interstices of a deep and complicated wound, the potentialities of a surgical catastrophe.

That the bullet is infected by passing through muddy skin or clothing, often carrying with it portions of the latter, seems fairly certain. Some wounds in South Africa became infected when the bullet passed through the mouth or any part of the alimentary tract, both highly infective regions of the body. The bullet itself, when fired, is probably a fairly clean body from a surgical point of view. The sides are cleaned by the friction of the rifle barrel, and the base is seared by the flame of the explosion. Nevertheless Col. La Garde's experiments have shown that if deliberately infected before firing, it can be shown to be still carrying infection after firing.

The problem, then, which was presented by gunshot injuries was how best to combat sepsis in punctured wounds of all varieties, complicated often by bone injury and severe lacerations of soft parts, the bacterial infection coming usually not from the wound openings, but being deeply implanted by the actual stroke of the bullet as it passed through the tissues. Obviously, the mere application of even the most efficient antiseptics to the parts about the external wounds will not meet such a case. The infection must be attacked in the depths of the tissues, preferably at a very early date after the receipt of the wound, before the bacteria have time to multiply in the tissues. Moreover, practically all wounds of any depth must be dealt with thus. It would be bad surgery to wait until the infection was established, even though few signs of mischief appear at first. Accordingly it was soon recognised that the wound must be opened up, cleaned as far as possible, foreign bodies removed, and free exit provided for discharges by means of drainage tubes.

Some surgeons hoped that in a wound thus opened up, and thereby converted from a punctured to an incised type, it might be possible to remove the infection altogether, and here the advocates of the application of strong antiseptic solutions had their view. A mass infection can be completely destroyed by the application of, say, pure carbolic acid. At a very early stage of infection this may perhaps be possible, but not when the bacteria are in the depths of the tissues. Moreover, it is difficult to reach all the recesses of a large wound, and if one pocket is left unattacked, the surgeon's pains are thrown away. Strong antiseptic solutions, too, are very damaging to the tissues, which, it must be remembered, are in a condition of impaired vitality already. Another drawback to the use of antiseptic solutions, whether weak or strong, is the fact that many of them tend to become inoperative when in contact with the albuminous solutions like blood or pus. They form inert compounds with albumin, and will no longer destroy bacteria. It is claimed for an entirely new antiseptic, called from its colour flavine, that it actually proves more formidable to germs when in solution in blood-serum than in aqueous solution. But further trial is required before its value can be exactly classified.

Another device for the early removal of septic matter is to cut away the infected tissues bodily. The extremely localised nature of gunshot injury is a help in this case. It is possible to excise the entire internal surface of the wound *en masse*, with all its sinuosities and pockets, and to sew up the clean cavity remaining. This method enjoys the advocacy of Col. H. M. W. Gray, who has had success with it, but to be satisfactory it obviously must be done early, and requires in many cases considerable surgical skill. Cranial injuries and wounds of joints have been treated by this method with an encouraging measure of success.

But both the above methods can be effectively applied only when the wound is seen early, and in warfare this is not always possible. Many hours or even days may elapse before wounded men can be collected and carried to the casualty clearing stations. What, then, can be done when bacteria, deeply implanted in the tissues, are multiplying freely and in circumstances very favourable to their growth? Here the physiologist steps in and reminds the surgeon that the living body has its own guards against bacterial invasion; that healthy blood fluids are inimical to the growth of many, though not of all, bacteria; that the white corpuscles, the so-called phagocytes or germ-eaters, form an immense army for home defence; and that the effect upon the body of the absorption of the special toxins produced by bacterial action is to cause it to elaborate a neutralising substance or antitoxin. Here, then, is the physiological basis both of the salt method and of the vaccine method of treatment. It is found that if a strong or saturated solution of common salt be applied to an infected wound, the salt by its osmotic action sets up a greatly increased flow of lymph from the tissues into the wound, thus relieving the inflamed tissues of congestion, and setting up a flow of fluid from within outwards which tends to wash away bacteria. Both the lymph and the strong salt solution are unfavourable to the growth of bacteria. So far as the white corpuscles are concerned, strong saline solutions are unfavourable to their vitality; but when the wound has become healthier it is usual to decrease the strength of the salt solution until its saturation has reached that of a fluid of the same specific gravity as the blood. In a fluid of this degree of concentration the phagocytes can live and act freely.

The practical application of these principles consists either in packing the wound with gauze, between the folds of which tablets of salt are placed, or arranging for the continuous irrigation of the wound with a solution of salt of a known concentration. The latter method is suitable in a fixed hospital. And it is one of the great advantages of the former method that a case so dressed often requires no redressing for a few

days, so that the anxieties connected with the provision of fresh dressings during transport from the casualty clearing station to the base hospital are set aside. The question of treatment by vaccines can scarcely be efficiently dealt with within the limits of a short article. In any case the *rôle* of vaccines is to neutralise tissue poisons elaborated by bacteria, rather than to contribute directly to the closing and healing of the wound itself. The ideal vaccine would naturally be one which, injected into the body immediately after the wound is inflicted, has the power of getting in ahead of the toxins and neutralising them. This prophylactic action is possessed by one of the serums used, and fortunately in the case of one of the deadliest of the bacteria, the tetanus germ. It has been found that the use of this serum in a moderate dose immediately after the infliction of the wound protects the wounded man from tetanus, and consequently an important part of the treatment at the casualty clearing stations is the administration of this preventive dose. As regards the other bacteria, serums and vaccines are used, but their value is not so well established as in the case of tetanus, though important results have been obtained and valuable lessons learnt from their trial.

It will be seen from the above remarks that surgeons had not only to appreciate and elucidate a problem which at first presented many new and puzzling features, but also to devise means for its solution. How far they have been successful cannot be quite known until after the war. But enough experience has been gained to justify the hope that we are on the right track, and that the treatment our brave soldiers have a right to expect can now be given to them.

NOTES.

AN article of immediate interest and importance appeared in our contemporary *La Nature* (February 17, p. 100) on the utility of supplying soldiers with body armour—a proposal which has been already urged in this country. The writer, "A. G.," states: (1) That in trench warfare nearly 75 per cent. of wounds seen in hospitals are caused by missiles of low velocity—such as could have been warded off by a comparatively thin armour-plate. (2) That missiles of low velocity which lodge in the body are more dangerous to life than missiles of high velocity which penetrate and leave the body, because every missile which lodges is presumably an infected body. (3) That the total mortality from head wounds has been enormously decreased since the introduction of protective helmets. The form of body armour proposed by the writer in *La Nature* is fully illustrated and compared with suits worn by soldiers in the Middle Ages. A cuirass of armour-plating is proposed for the protection of the thorax and upper abdomen, covering the most vital organs; a gorget of chain mail protects the neck, and a girdle or short "kilt" of the same material the loins and groins; there are a mask for the face, and sheaths for the shoulders, elbows, and knees. How far such an armour would interfere with mobility is a matter on which only military men can decide, but from a surgical point of view such a protection has every recommendation. We may here point out that a soldier of average stature presents, as he faces the enemy in open field, a target with an area of 2740 square cm. Of that target the head and neck make up 9 per cent.; the thorax and abdomen 28 per cent.; while the less vital parts—the limbs—make up the largest part, viz. 63 per cent. Even if only the more vital parts could be protected, there would be a great saving of life.

THE Committee on Commercial and Industrial Policy, of which Lord Balfour of Burleigh is chairman, has recently forwarded to the Prime Minister a copy of resolutions passed on the subject of Imperial preference, and its report (Cd. 8482, price 1*d.* net), which includes a copy of the covering letter addressed to the Prime Minister, has been presented to Parliament. In the light of experience gained during the war, the committee contends that special steps should be taken to stimulate the production of foodstuffs, raw materials, and manufactured articles within the Empire, wherever this is possible, and it therefore recommends that preferential treatment should be accorded to the products and manufactures of the Colonies, either by exemption from, or reduction of, duties. Such recommendations from the committee, composed as it is of well-known representatives of politics, economics, engineering, metallurgy, trade, and industry, will no doubt carry considerable weight. There is, however, one direction in which this committee ought to be strengthened. Since the beginning of the war the importance of applied chemistry has become obvious to everyone, but it is not yet sufficiently realised by Government Departments and public officials that there are many industrial and economic questions in the consideration of which some knowledge of the science of chemistry and its applications, actual or potential, is indispensable. These questions cannot be handled with success by ordinary men of business, however able, without such knowledge, and it appears therefore eminently desirable that a duly qualified representative of chemical industry should be added to the committee.

COUNT ZEPPELIN is dead, and has left a name that brings to our minds the murder of innocent women and children in air-raids over open towns. Yet it must be admitted that his work in developing the rigid airship, in spite of many failures, is worthy of all praise. Count Zeppelin showed us how far the rigid airship can be developed, and the war has shown us the use and abuse of such aircraft. As scouts for the navy they are invaluable, being able to hover over one spot for lengthy periods without wasting their fuel reserves, a manœuvre impossible to an aeroplane. It is, however, clearly recognised that the use of airships for raiding open towns is quite indefensible, and that as a means of invasion they are very unlikely to prove a serious menace. In peace time they might be used to convey mails and passengers, but their speed is not higher than that of an express train, and their liability to destruction in bad weather is a serious objection to these uses. In spite of Count Zeppelin's painstaking labours, in face of great difficulties, it does not seem that his rigid airships are ever likely to be serious rivals of the aeroplane, either for military or commercial purposes.

IT is interesting to learn that the Imperial Institute proposes to constitute a comprehensive bureau of mineral intelligence, with the object of supplying information as to all mineral deposits within the British Empire. For some years past the Imperial Institute has been doing a certain amount of such work, and it will be a decided advantage to have a mineral intelligence bureau available to the public. This subject

has occupied the attention of several similar institutions. A paper dealing with the occurrence and distribution of certain of these minerals, read by Prof. Cullis before the Society of Engineers on December 11, 1916, was summarised in NATURE of January 4 (p. 361); and it is understood that the Department of Scientific and Industrial Research is also moving in the same direction. None of these attempts, however praiseworthy and valuable, can take the place of a properly established Government Department of Minerals and Metals, which should co-ordinate all these scattered efforts, and should deal with the whole subject from the point of view of a great Imperial industry, which is of vital importance to the future of the British Empire. This is surely a subject for the Government, and should not be left to the enterprise of individuals or associations, and there is probably no way in which public money could be expended with a better assurance of prompt and manifold reimbursement.

THE resignation of Dr. E. A. Letts from the chair of chemistry in the Queen's University, Belfast, is announced.

SIR W. E. GARSTIN and Sir G. K. Scott-Moncrieff have been elected honorary members of the Institution of Civil Engineers.

THE third Guthrie lecture of the Physical Society will be delivered in English at the Imperial College of Science and Technology on Friday, March 23, by Prof. P. Langevin. Its subject will be "Molecular Orientation."

THE twenty-second annual congress of the South-Eastern Union of Scientific Societies will be held at Reading on June 6–9, under the presidency of Prof. E. B. Poulton.

WE learn from *Science* that Dr. V. M. Slipher, for many years chief assistant at the Lowell Observatory, and known for his spectroscopic researches, has been appointed director of the observatory in succession to the late Percival Lowell.

THE *Times* announces that Dr. Douglas W. Freshfield, president of the Royal Geographical Society, has been elected an honorary member of the Russian Geographical Society, and Sir Ernest Shackleton a corresponding member.

WE regret to announce the death, on March 9, at eighty-eight years of age, of the Rev. O. Pickard-Cambridge, F.R.S., author of "Specific Descriptions of Trapdoor Spiders" (1873), "The Spiders of Dorset" (1879–81), and other works on arachnology, entomology, and general natural history.

WE are glad to be able to state that the announcement made at the meeting of the Linnean Society on February 15 as to the death of Prof. G. O. Sars, the distinguished zoologist of Christiania, is incorrect. The mistake arose from a confusion of his name with that of his brother, J. E. Sars, professor of history in the same university, who died recently.

THE Right Hon. Sir William MacGregor, late Acting High Commissioner for the Western Pacific; Sir William Peterson, principal of McGill University, Montreal; and Sir Ernest Rutherford, professor of physics, University of Manchester, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

LETTERS on the optical deterioration of the atmosphere during July and August last appeared in NATURE of October 5, November 9, and December 28, 1916. Father J. G. Hagen, director of the Vatican Observatory, writes to say that the defects referred to were severely felt at that observatory, and were attributed, as was done by Prof. Riccò in NATURE of November 9, to the eruption of Stromboli, which reached its maximum on July 4. Father Hagen has recorded these facts in the *Astronomische Nachrichten*, No. 4871.

THE following is the list of officers of the Physical Society elected for the ensuing year: *President:* Prof. C. Vernon Boys. *Vice-Presidents* (in addition to those who have filled the office of president): Mr. W. R. Cooper, Sir Napier Shaw, Dr. S. W. J. Smith, Dr. W. E. Sumpner. *Secretaries:* Prof. W. Eccles, Finsbury Technical College, Leonard Street, E.C.; Dr. R. S. Willows, The Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. *Foreign Secretary:* Dr. R. T. Glazebrook. *Treasurer:* Mr. W. Duddell. *Librarian:* Dr. S. W. J. Smith. *Other Members of Council:* Dr. H. S. Allen, Prof. E. H. Barton, Prof. G. W. O. Howe, Prof. J. W. Nicholson, Mr. C. C. Paterson, Mr. C. E. S. Phillips, Prof. O. W. Richardson, Dr. S. Russ, Mr. T. Smith, Mr. F. J. W. Whipple.

MR. JAMES GILLINGHAM, of Chard, recently presented to the County Museum at Taunton a large number of photographs and papers collected by him for the purpose of perpetuating the memory of John Stringfellow, of Chard, "the pioneer of flight and father of aviation." Nine of the photographs, mostly enlargements, are mounted on cards as follows: (1) Portrait of John Stringfellow; and (2) another as an old man; (3) Stringfellow's aeroplane, 1848; (4) his triplane, 1868; (5) another view of his triplane; (6) flower show and sports on Bewley Down, near Chard, the place where Stringfellow experimented with his flying-machine in 1847; (7) aeroplane designed by W. S. Henson and patented as "The Ariel Steam Carriage, 1842"; (8, 9) two photographs of the memorial to Stringfellow in Chard cemetery, designed by James Gillingham; in addition, the original drawing of the last-named subject, in large frame. At the present time these photographs are exhibited in a case in the Great Hall of Taunton Castle. The collection contains a good deal of miscellaneous manuscript and printed matter having reference to aviation, and includes the memorandum of agreement made by John Stringfellow and W. S. Henson with regard to a partnership for constructing "a model of an aerial machine," dated December 29, 1843.

By the death of General J. A. L. Bassot, on January 17, international geodesy has sustained a severe loss, and France mourns a distinguished geodesist. Born in 1841, General Bassot took part in the war of 1870, and immediately after it was appointed to the Service Géographique de l'Armée, where, under General Perrier, he was employed on the remeasurement of the arc of meridian in France. Later, in 1879, he took part in the geodetic operations for connecting the triangulation of Spain with that of Algeria, where Bassot occupied the mountain station of Filhaoussen for nearly eight weeks before he could effect his purpose. In 1884 he laid out and observed the chain of triangulation from Algiers to Laghouat, and a few years later, in 1888, he succeeded his former chief, General Perrier, as director of the Military Geographical Service. Administrative duties now put an end to his geodetic work in the field, but he continued to direct and promote geodetic operations of import-

ance, in spite of the arduous work and heavy responsibilities which the provision of maps for the French Army entailed. In these, too, he made numerous improvements. The remeasurement of the arc of meridian in France naturally suggested a revision of the arc of Peru, which had been measured in the eighteenth century in connection with the geodetic operations in France. A proposal to this effect was warmly supported by the International Geodetic Commission at its meeting at Stuttgart in 1898, and in June, 1899, work was commenced under the direction of General Bassot, and has since been carried to a successful termination. At several meetings of the International Geodetic Commission General Bassot presented reports on various geodetic operations, and at its meeting of 1903 he was elected president, which post he held until the commission automatically ceased to exist at the end of 1916, a few days before his death. On his retirement from the Army he became director of the Observatory of Nice in 1904, and devoted his energies to scientific work there and to his geodetic studies, besides taking part in an expedition to Spain in 1905 to observe the eclipse of the sun of that year. He was elected a member of the Académie des Sciences in 1893.

THE *Journal of Mental Science* for October, 1916, contains an interesting article by Prof. E. W. Scripture on "Reaction Time in Nervous and Mental Diseases." The fact that we judge whether a person is normal or not by our observations or how he reacts to his environment suggests that the study of nervous and mental diseases would be furthered by having some method by which we could study in detail the reactions of a patient to various stimuli. The usual reaction time apparatus is complicated, and involves much laborious calculation before the records can be utilised; it is therefore unsuitable for clinical work. The author of the article has devised, in order to obviate this, a self-recording method that shows directly to the eye, without measurement, how quick the reaction time is and how it varies. He gives details of records obtained with this apparatus from normal people and from patients suffering from alcoholism, hysteria, epilepsy, and general paralysis. The few diseases studied show marked reaction types, even for the simple form of reaction, and the author thinks that the test can be made so complete and trustworthy as to give an accurate diagnosis of many nervous diseases.

PROFS. M. BOULE and R. Anthony, in the *Journal of Anatomy* for January, make a spirited reply to Prof. Symington's strictures on deductions drawn from endocranial casts taken from human skulls. In their paper, "Neopallial Morphology of Fossil Men as Studied from Endocranial Casts," they contend that Prof. Symington's mistake lies in assuming, implicitly and without question, that what is true of modern men must also, necessarily, be true of Neanderthalians. As a matter of fact, they show that, while in modern man furrows are to be seen only at the base of such brain casts, in Neanderthalians these furrows are traceable on the frontal and occipital regions. They also show that in the case of the lemurs, and in carnivores and ungulates, endocranial casts show the neopallial foldings over the whole brain, which can be read on a cast nearly as easily, and with as much exactitude and precision, as on the surface of the brain itself.

ACCORDING to *Commerce Reports* (Washington) of June 12, 1915, nearly 400 square miles of seaweed-beds exist along the United States Pacific coast. From this area it is officially estimated that 59,000,000 tons of seaweed might be cut annually, from which 2,300,000 tons of potassium chloride could be produced. Arrangements have been made by the United States Department of Agriculture for experimental work on the production of potash from this seaweed to be carried out on a commercial scale. In the New York *Journal of Commerce* of November 24 (quoted in the *Journal of the Board of Agriculture*, February, p. 1158) it is stated that an appropriation of 175,000 dollars has been made for the purpose, and that the plant will probably be established in southern California, either at Santa Barbara or Long Beach. A plant capable of dealing with about 200 tons of wet seaweed per day will be erected, and a daily yield of about five tons of potassium chloride is expected. Numerous methods will be employed experimentally, but for the most part distillation processes will be used.

IN a recent communication from the National Health Insurance Commission (England) to the Board of Agriculture and Fisheries the opinion is expressed that of the many home-grown plants used in the treatment of disease only four can be regarded, from a medical point of view, as really essential—namely, belladonna, henbane, digitalis, and colchicum. The communication, which is published in the February issue of the *Journal of the Board of Agriculture*, proceeds further to give approximate estimates of the amounts of these essential plants required annually for home consumption, ranging from about 50 tons each of dried leaves and roots in the case of belladonna to about 20–25 tons each of dried leaves of henbane and digitalis, and a much smaller quantity of colchicum. It appears that there is sufficient digitalis and colchicum growing wild in this country to meet home requirements, and that a considerable proportion of the home demand for belladonna and henbane could also be met by the collection of wild plants with well-organised schemes for collection and drying. Moreover, the cultivated area under belladonna and henbane has considerably increased since the outbreak of war, and probably now suffices, together with the supplies obtainable from wild plants, for home requirements.

THE relation of the geographical conditions to the present situation in Mexico, as it may affect the United States, is the subject of some notes in the *Geographical Review* for January (vol. iii., No. 1). It is pointed out that the scene of action, if the United States intervenes in the affairs of Mexico, must be in the thinly peopled and arid northern frontier regions, where conditions are greatly in favour of the Mexicans. Water is scarce, and transportation of men, food, and materials will be difficult, which will handicap the Americans, but, on the other hand, will be correspondingly an advantage to the Mexicans, habituated to life in these desert conditions. A campaign in northern Mexico would therefore involve transport arrangements costly out of all proportion to the number of troops employed, and it would be far removed from the high plateau on which are situated nearly all the great cities of Mexico and most of its population. The article has a short but useful bibliography of geographical works on Mexico, and is accompanied by a map of the northern frontier regions.

IN a paper in the *Geographical Journal* for February (vol. xlix., No. 2) Mr. C. B. Fawcett has tried to devise administrative divisions for England and Wales more rational and more in harmony with local and regional consciousness than the divisions into counties. The aim of his divisions is to facilitate good local government. This entails certain considerations.

The boundaries must be drawn so far as possible along the more thinly peopled tracts of land. Each province must have a regional capital. This is essential to the development of a provincial patriotism necessary for good government. The minimum of population in each province should be about one million, and no province should be so populous as to dominate the others. It is a sound geographical principle that a valley forms a unity, and so boundaries should be drawn near watersheds. Lastly, as the new boundaries to some extent supersede the ancient counties, county patriotism must be allowed for in determining the new provinces. The result, as illustrated by a map, is to divide England and Wales into thirteen provinces centred respectively round London, Cambridge, Oxford, Southampton, Bristol, Plymouth, Cardiff, Birmingham, Nottingham, Leeds, Manchester, Newcastle, and an unchosen capital for the south-east province. While the various provinces are not intended to be equal in importance any more than they are in area, it is difficult to admit of any adequate division of Metropolitan England, to use Mackinder's term, which is, and must be, dominated by London. In the north the problem is easier.

We have received a copy of the Egyptian Almanac for the year 1917 (Government Press: Cairo). The almanac is descriptive rather than statistical, and so forms a complementary volume to the Annuaire Statistique. There are chapters on the geographical features, agriculture and industries, and on the work of the various public departments. The section on the antiquities department has been considerably extended, and contains a list of the principal antiquities and monuments of art. A transliteration system of Arabic is added to the almanac. It would have enhanced the usefulness of the volume if a list of maps published by the survey department had been added.

A RENEWAL of wintry weather occurred in all parts of Great Britain on the three days March 7–9, and the cold snap was greatly intensified by a keen and searching easterly wind. Slight snow was experienced generally. On March 7 the highest day temperatures failed to rise above the freezing-point at most of the health resorts reporting to the Meteorological Office in the northern and eastern English districts. On March 8 the minima, or lowest temperatures, in the early morning were below 20° over Scotland, as well as at places in the north of England. At Aberystwyth the sheltered thermometer fell to 19° and at Bournemouth to 22°. In the London suburbs the lowest temperatures in the screen were generally about 22°, and at Hampstead the thermometer fell below 20°. The day temperatures were almost as low as on March 7. On the morning of March 9 the thermometer reading was again very low, registering 15° in parts of Scotland, and 20° at several stations in the east and south-east of England, as well as in the London suburbs. Much milder weather, with rain, set in over the south-west of England, and the change spread rapidly to other parts of Great Britain.

COMMUNICATION 149 from the Physical Laboratory of the University of Leyden contains the results of the measurements of the specific heat at constant pressure of solid and liquid nitrogen carried out by Prof. Kamerlingh Onnes and Dr. W. H. Keesom. The pure nitrogen used was condensed and entered the calorimeter at a low temperature. It was there heated electrically through a range of temperature of about a degree, and the work done and the rise of temperature observed. The calorimeter was enclosed in a vacuum jacket kept at a low temperature to diminish the flow of heat from its surroundings. The atomic heat of the solid nitrogen at 15° Absolute is 1·6, at 20° 2·4, at 40° 4·5, at 50° 4·9, and at 60° 5·3. The atomic heat of the liquid nitrogen above the triple point 63° is 6·6 up to 76° Absolute.

A NEW list of small electric furnaces, for temperatures up to 1000° C., has just been issued by Messrs. A. Gallenkamp and Co., Ltd. These furnaces are characterised by a simplicity of construction and ease of manipulation which should render them of considerable value in chemical and other laboratories. The general advantages of electric furnaces are well known, but by many it may not yet be realised how much more convenient their use has become since the introduction of high-resistance, high-melting-point alloys, such as are employed in the apparatus referred to here. These materials enable small furnaces to be wound for use on voltages up to 250 (direct or alternating), while the low-temperature coefficient of the winding obviates the continued attention during heating-up that is demanded by a platinum or nickel wound furnace. In addition, the renewal of the heating tube, should breakdown occur through accidental over-running, is quickly carried out and at small cost. The types listed comprise a good selection of single and multiple tubular furnaces for combustion and explosion tube work. Muffle furnaces suitable for general chemical analysis and for small metallurgical operations are constructed on similar lines, while a vertical crucible furnace has recently been included in the list. This latter piece of apparatus is provided with a device for lifting the crucible from the heating tube from below —an arrangement which should greatly conduce to ease of working. The list gives useful information as to the power consumption for each size of furnace, while prices of renewal tubes and of suitable regulating resistances are quoted in each instance.

A PAMPHLET entitled "Slav Achievement in Advanced Science," by Prof. B. Petronievics, of Belgrade (American Book Supply Co., Ltd., 1s.), contains brief accounts of the following worthies: (1) Copernicus, (2) Boscovich, (3) Lobachevski, (4) Mendeléeff. They are all interesting, and (2) and (4) are particularly good. Even to an English reader (1) goes over familiar ground, and (3) contains blemishes in detail which make it rather untrustworthy. Thus from p. 19 the reader would infer that CD in the figure is a "straight" line; on p. 21 it appears as the locus of points "equidistant" from AB, and is, therefore, not a straight line. Riemann's "plane" (p. 22) cannot be *constructed* in Euclidean space, but we have an exact image of it in ordinary spherical geometry; *i.e.* we can translate any formula of the latter into a formula for the Riemann plane. Similarly, formulæ for the so-called pseudosphere in ordinary space can be applied to the geometry of a plane in Lobachevski's space. As illustrations of recent advance in scientific thought, we may remark that no one now would claim for Copernicus's theory any absolute superiority over Ptolemy's; it is only a matter of choosing axes of reference assumed to be fixed, and since the sun undoubtedly moves with reference to the fixed stars, the simplest explanation of celestial motions compels us to discard the Copernican axes, at any rate as a fixed system. Again, the theory of electrons has brought in a mathematical analysis which in some respects is analogous to Boscovich's. We are glad to learn that Prof. Petronievics is about to publish a work "On Simultaneous Discoverers"; this ought to be very interesting.

FROM the early days of the industries based on coal-tar products it has been fashionable to illustrate the

derivation of synthetic dyes and other commercially important substances from coal-tar by diagrams somewhat on the lines of a genealogical table. This method of demonstrating the importance of coal-tar and the direct products of its distillation becomes increasingly difficult each decade, because of new developments which are constantly being made. Messrs. G. Allen and Unwin, Ltd., are responsible for the publication of one of the latest of these "coal-tar charts," which was adapted by Dr. T. H. Norton from a diagram originally drawn up by Dr. von Brunck, the veteran director of the Badische Aniline and Soda Company. In this chart the genesis of many important modern dyes is traced from six direct or immediate coal-tar derivatives, namely, benzene, toluene, the xylenes, naphthalene, phenol, and anthracene. Among the recent additions are the substantive wool dyes of the anthraquinone series, of which alizarine saphirol may be taken as type. The direct cotton-blues are valuable colours, the derivation of which from tolidine and dianisidine is indicated, and reference is made to some of the more important chromed colours. It is, however, significant of the rapidity with which these charts become obsolete, that in the present instance no place is found for the direct coal-tar product, carbazole, and its important derived colour, hydrone-blue.

The North-East Coast Institution of Engineers and Shipbuilders has just issued a standard specification for cargo-steamer engines. This specification is for reciprocating triple-expansion engines intended for moderate-speed cargo-boats engaged in general trade, and is based on the best practice of the day; the object in view is the ultimate standardisation of parts. It is hoped that the specification will be extended to include not only the main engine proportions and scantlings, but also the boilers, auxiliaries, and other details. The council proposes that an annual revision should be made in order that the specification may be kept thoroughly up to date. In view of the tasks which will have to be faced directly the war is over, the specification and proposals are of importance, and will tend to improve the organisation of our shipbuilding industry in this class of vessel.

OUR ASTRONOMICAL COLUMN.

Eclipse Test of Einstein's Theory of Gravitation.—At the meeting of the Royal Astronomical Society on March 9, the Astronomer Royal directed attention to the favourable opportunity which would be afforded by the total eclipse of the sun on May 28, 1919, for testing Einstein's predicted deflection of a ray of light in passing close to the sun. The theoretical displacement of a star near the sun is $1{\cdot}75'' \, r_0/r$, where r_0 is the sun's radius, and r the perpendicular distance of the ray from the sun's centre. At the eclipse of June, 1918, visible in the United States, the sun will be situated in a region poor in stars, but on May 28, 1919, it will be in the Hyades group. There will then be thirteen stars in the vicinity of the sun, of magnitudes 4·5 to 7·0, for which the theoretical displacements range from 1·20″ to 0·26″. The greater part of the track of this eclipse will unfortunately be over the Atlantic, not far from the equator, but, in view of the importance of the suggested observations, it is hoped that suitable observing stations may be found in Brazil or Liberia. A re-examination of the photographs taken by the Greenwich observers at Sfax in 1905 revealed three star images, and a possible fourth image involved in the corona, but no trustworthy deduction as to the reality of the Einstein effect could be made. These photographs, however, show that the standard astrographic telescope employed is quite a suitable instrument for the purpose in view.

The Variable Nebula N.G.C. 2261.—Dr. V. M. Slipher, director of the Lowell Observatory, has obtained a spectrogram of Hubble's variable nebula N.G.C. 2261, to which reference has previously been made in this column (Nature, vol. xc., p. 298). The nebula is of cometic form, and has the irregular variable star R. Monocerotis as its nucleus. The nebula and star have been found to show the same peculiar spectrum, consisting of a continuous spectrum with bright lines or bands which are not identical with those of gaseous nebulæ. The observation suggests that the nebula shines by reflected light of the pulsating nucleus. Mr. Lampland has obtained two direct photographs with the 40-in. reflector, one on March 2, 1916, and the other on January 25, 1917, showing striking differences in parts of the nebulous detail. The magnitude of the apparent changes suggests that no actual transference of matter takes place, but rather that we witness the progressive motion of pulses of light resulting from fluctuations in the brightness of the variable star. The displacement is estimated at 15 seconds of arc, and, assuming this to be perpendicular to the line of sight, which would generally overstate the distance, the parallax of the nebula would be about 0·00027″. The corresponding distance would be 12,000 light-years.

THE CHEMICAL ENGINEER.

The president and council of the Faraday Society are to be congratulated on their enterprise in organising a very successful debate on the training and work of the chemical engineer held on March 6, which supplements the discussion in November last on the same subject before the London section of the Society of Chemical Industry. The importance of a knowledge of engineering to the chemist engaged in industry was accepted by all present, but the speakers showed a great difference of opinion in their definition of the chemical engineer. Sir George Beilby, who initiated the discussion, considered that chemical engineering has for its function the design and construction of apparatus required for the carrying out of chemical processes on a manufacturing scale. The chemical engineer is a specialist who not only has at his command a sound knowledge of chemical phenomena and laws, but, more important still, he must be able to see chemical problems from the chemist's point of view.

Prof. Donnan drew a distinction between research chemists, engineer-chemists, and chemical engineers, using the last term in the same sense as Sir George Beilby. The engineer-chemist is the ordinary chemical student to whom a good deal of engineering knowledge has been imparted. or, as Prof. Donnan termed it, applied physical chemistry. He corresponds to what is usually known as the plant chemist in chemical industry—that is, the trained chemist who has naturally mechanical aptitude and has gained engineering knowledge by experience. Prof. Donnan's desire was to include a comprehensive training in engineering in the four years' course for chemists. It was suggested that some attempt should be made by the teacher at the end of three years to state as to what branch of chemistry a particular student showed the greatest aptitude. Prof. Donnan very properly laid considerable stress on the rarity of the really gifted research worker, who was born rather than made by training.

Even more important in this connection was Sir

George Beilby's statement that the point of view of the engineer is not so far removed from that of the ordinary intelligent person that the latter cannot grasp, in a general way, his aims and objects; but the thoughts and aims of the chemist are for the most part quite inscrutable to the vast majority of his fellow-men. Since the chemist's views are so much further removed from everyday notions and conceptions than are those of the engineer, it is wiser first to imbue the mind of the student thoroughly with the more difficult, because less ordinary, point of view.

On the other hand, many of the speakers seemed to advocate that chemists should be trained as chemical engineers—that is, primarily to design and control chemical plant; and that the factor of cost in relation to chemical processes should not be overlooked. From the point of view of the chemical manufacturer, it was urged that the main requirement of the industry was men fully equipped with a real knowledge of chemistry: the individual with mechanical aptitude would without difficulty be able to learn enough to think as an engineer, and appreciate engineering problems.

In addition to the scheme outlined by Prof. Donnan for the training of the would-be works chemist in engineering, papers were contributed by Mr. C. H. Darling on the training in physics given at the Finsbury College, and by Mr. J. W. Hinchley on the course at the Imperial College. The former course is designed to make the student acquainted with the type of instrument he will later meet with in works, but it was recognised by Mr. Darling that the young chemist who is to be of the maximum use to his employer must, in addition to the possession of specific knowledge, have his ideas running in the right grooves.

HIGH-SPEED TELEGRAPHY.

THE report of the committee appointed by the Postmaster-General in December, 1913, to consider the question of high-speed telegraphy has now been issued in the form of a White Paper (Cd. 8413, price 3*d*.). Unfortunately the work of the committee was interfered with by the outbreak of war in August, 1914, which cut short a series of tests designed to show the best results which various competing systems could produce under identical conditions. In the absence of comparative statistics the complete examination of all the claims of rival inventions is impossible, but as such minute statistical comparisons would be mainly valuable in connection with further investigation, the considerations on which the committee's recommendations have been framed should suffice for the present.

The question before the committee resolved itself into a rivalry between automatic high-speed systems on one hand, and the multiplex on the other, though the inventions of Mr. Creed and the advent of various keyboard perforators affected the situation of the former. Automatic high-speed systems were fully reviewed, but the conclusion arrived at by the committee is that for ordinary commercial telegraph work between the main centres of the British Post Office service the inventions based on the multiplex method are superior, as they conduce to economy in staff, are subject to fewer serious stoppages and delays than automatic systems, and necessitate less spare plant and less costly maintenance. The fundamental principles of nearly all multiplex instruments are based on the Baudot system, invented more than thirty years ago. Ten years later it assumed, in the hands of the original inventor, practically its present form. Although some of its main principles had been anticipated by earlier inventors, Baudot was the first who combined them into a system of practical utility, and the production of the system may be regarded as marking an epoch in the history of telegraphy. The leading features of the Baudot system are: (1) its method of obtaining synchronism; (2) its direct transmission from keyboard to line; (3) its cadence and speed; (4) its direct printing on slip.

Of the multiplex systems at present available, the Western Electric is said to have given the best results, and the committee recommends that a number of quadruple duplex installations of this apparatus be ordered. Seven or eight sets should suffice, as although present conditions favour the rapid application of systems with the greatest output, it is desirable to avoid too great a dislocation of working, and to allow time, so far as possible, for other makers to demonstrate their capabilities. Page- or column-printing is preferable to tape-printing on the busiest routes, and the Western Electric Company's page-printing on a continuous roll of paper, cut off after each message, is quite satisfactory. The committee does not consider it desirable that either page- or column-printing should be adopted throughout the service to the exclusion of tape-printing, while the Creed receiving apparatus is recommended for use in the Post Office news service. The application of printing methods to the less important circuits should be kept steadily in view, and early trials of the one-way and two-way installations of the Western Electric, and of the light line printer of the Automatic Telephone Manufacturing Company, are recommended. The committee was impressed with the possibility of two-way working with one operator at each end, both to signal their messages simultaneously to the other end, and then both to gum the tape. An hourly load can be carried in this way equivalent to the average Morse load with two operators at each end, and having the additional advantage of printing the telegrams. The committee predicts that the introduction of multiplex methods for news work will call for serious consideration in the near future, and it urges that the application of these systems, to give simultaneous communication on one wire between each one of three or possibly more offices, should be kept in view as multiplex methods are extended.

HEREDITY AND DISEASE.

IN the lately issued Bulletins Nos. 16 and 17 of the Eugenics Record Office (Cold Spring Harbour, New York) Prof. C. B. Davenport and Dr. Elizabeth B. Muncey discuss "Huntington's Chorea in relation to Heredity and Eugenics" and "The Hereditary Factor in Pellagra." Nearly a thousand cases of the chorea "can be traced back to some half-dozen individuals who migrated to America during the seventeenth century." The disease manifests itself in various sets of symptoms—nervous tremors, dementia, etc., —most of which act as dominants. Though the hereditary nature of the disease has been recognised for generations, "there is no clear evidence that persons belonging to the choreic lines voluntarily abstain to any marked degree from, or are selected against, in marriage." With regard to pellagra, there appears to be a distinct hereditary predisposition to infection; nearly half the children of a pair of susceptible parents are themselves susceptible.

The long-disputed question of the influence of poison on germ-cells has received another contribution in Dr. Raymond Pearl's paper on the effect of continued

administration of certain poisons to the domestic fowl, with special reference to the progeny (Proc. Amer. Phil. Soc., lv., 1916, pp. 243–58). This is an abstract of three papers from the Maine Agricultural Experiment Station, and a fuller memoir is promised later. A new feature in this research is that "the foundation stock used came from pedigreed strains of two breeds, Black Hamburgs and Barred Plymouth Rocks . . . whose genetic behaviour under ordinary circumstances may be predicted with a degree of probability amounting practically to complete certainty." The birds were treated by inhalation with ethyl alcohol, methyl alcohol, or ether, and examination of the offspring gave the surprising result that "out of twelve different characters for which we have exact quantitative data, the offspring of treated parents taken as a group are superior to the offspring of non-treated parents in eight characters." Dr. Pearl does not consider that his results contradict those of the experiments by which several recent workers—such, for example, as Laitinen and Stockard—have established the degenerate nature of the offspring of many alcoholised mammals. He points out that the strength of treatment may be such as to exercise a selection among the germ-cells, so that, through the elimination of feeble sperms and ova, a larger proportion than usual of vigorous gametes in the narcotised animals take part in the production of zygotes, whereas with a stronger treatment all the gametes are injuriously affected. It is likely that the germ-cells of birds may be less affected than those of mammals by such influence, and Dr. Pearl is certainly justified in asking for caution in transferring these results to problems of human inheritance, though he is apparently willing to accept at their face-value the much-disputed statistics of Elderton and Pearson, so loudly acclaimed as an excuse for alcoholic indulgence among mankind.

G. H. C.

THE U.S. NATIONAL RESEARCH COUNCIL.

UNDER the pressure of conditions of war, national advantage is being taken of the services which science can render, through committees or by the appointment of men of science to posts in Government departments. Definite problems have to be solved, and attention has to be concentrated upon them, though this means that the freedom which is the prime characteristic of exploration in scientific fields is necessarily restricted. In the United States at present there is no necessity of this kind; and the National Research Council is, therefore, free to develop a plan in which purely scientific investigation takes its essential place, without consideration of immediate problems of national defence and industrial demands. The council has recently sent a circular to the chief educational institutions in the United States recommending the formation of research committees such as have been established already at the Massachusetts Institute of Technology and certain other institutions at its suggestion. The obligations of men of science towards national defence and industry are not overlooked, but it is equally important to provide for the free scientific research upon which great developments will depend in the future as in the past. "We must not forget," says the council, "that pure science, not directly stimulated by patriotic impulse for national service or the promise of financial reward from industrial profits, should be accorded the encouragement which enlightened leaders of industry are so willing to concede as its due." We subjoin an abstract of the main points dealt with in the circular from which this quotation is taken.

Research Committees in Educational Institutions.

A very large proportion of the scientific research of the United States is conducted in the laboratories of educational institutions. It is now widely appreciated that contact with knowledge *in the making* is the most effective means of seizing and holding the student's attention. And it is also recognised that no greater injury can be done to the cause of science than to compel a promising investigator, fresh from the researches of his graduate years, to relinquish all hopes of further studies because of the complete absorption of his time and energy by other duties.

It is with the fullest appreciation of the difficulties which financial limitations involve, and with a sincere desire not to interfere with the just demands of the teacher's profession, that the National Research Council invites the co-operation of educational institutions in the promotion of research at this critical period in our national progress. We believe it to be feasible, without decreasing the efficiency of the university, the college, or the professional school as teaching institutions, to increase greatly their contribution to knowledge through research. Indeed, we do not hesitate to say that if a portion of the time now given to teaching were devoted to investigation, and if the courses of instruction were so altered as to take full advantage of this change, the educational efficiency of the institutions in question would be materially enhanced. In extending a request for the formation of research committees in educational institutions of high standards, which accord serious support to scientific research undertaken by the faculty and advanced students, we beg to direct attention to some of the possibilities which lie open to committees of this character.

Before sending out a general invitation, a preliminary test of the plan has been made in certain institutions. The Massachusetts Institute of Technology, Yale University, the University of Chicago, North-western University, and Throop College of Technology have already established research committees to co-operate with the council. In each case these committees are composed of the president of the institution, two or three leading members of the board of trustees who are interested in research, six or more faculty members engaged in research, and two or more members of the alumni occupied with research or interested in its promotion. Following the example, at least for the present, of similar organisations abroad, the council has directed its activities to the promotion of research in chemistry, physics, engineering, mathematics, astronomy, geology and palæontology, geography, botany, agriculture, zoology and animal morphology, physiology, medicine, hygiene, psychology, and anthropology. There is no reason, however, why other departments of research should not be represented on the research committees of educational institutions wherever this appears desirable.

In view of the importance of encouraging research on the part of members of the faculties of colleges which do not undertake graduate instruction, the invitation of the council is not limited to universities and other institutions now giving specific recognition to research. It is highly important to encourage competent men to continue the work of research begun in their university career, and a sympathetic research committee could help greatly in this respect. Even the existence of such a committee should serve as a valuable stimulus to men who properly look for some measure of encouragement. In small institutions powerful support can be given to research by a body of men who genuinely appreciate its significance.

As the invitation of the council is being rather widely extended, a word of caution may not be out of place at this point. In the case of institutions not in a position to give serious support to research, it would evidently be inadvisable to appoint research committees. It is quite possible, however, that the strong moral support which could be given by a committee, even if it were unable to command large financial aid, would justify its formation. Indeed, it is scarcely conceivable that a research committee really in sympathy with the objects we have in view could fail to secure valuable material assistance to competent investigators.

Each research committee will doubtless discover its own best method of procedure, adapted to the circumstances of the case. The following suggestions as to possible lines of work may nevertheless be of service in organising the committees:—

(1) Prepare a survey of the research already in progress in the institution in question.

(2) Assist in the preparation of a national census of research indicating the equipment for research, the men engaged in it, and the lines of investigation pursued in Government bureaux, educational institutions, research foundations, and industrial research laboratories.

(3) Increase the supply of suitably trained men to carry on research work. The tendency towards narrow specialisation, so common at present, should be counteracted by developing more interest in science as a whole. Lectures on the history of science, and broad courses on evolution, covering its various aspects from the constitution of matter and the evolution of stars and the earth to the rise of man and the development of civilisation, should be widely encouraged. From the purely educational point of view such courses may be expected to produce a more favourable influence and leave a more lasting impression than routine discussions of the minutiæ of the various branches of science, though the latter are obviously essential in the training of the investigator.

(4) Develop a wider appreciation of the part which men of science may play in researches bearing both on industrial progress and national defence, including those of ship design, aeronautics, the fixation of nitrogen, and many other subjects.

(5) More general co-operation and co-ordination in research, within each educational institution and in alliance with other workers outside, is another important subject for consideration.

(6) Interchange of research workers, especially to secure for the smaller institutions the stimulus given by leaders of research, should be strongly encouraged.

(7) Establishment of a large number of research fellowships, each yielding one thousand dollars or more annually.

(8) Establishment of research professorships and research endowments.

(9) Encouragement of the *spirit* of research, and the development of a sympathetic atmosphere in which the investigator can work to the best possible advantage.

Central Committees on Research.

The National Research Council, with the co-operation of the American Association for the Advancement of Science, the American Chemical Society, the American Physical Society, the American Mathematical Society, and other national scientific societies, has established a series of central committees to organise research in the various branches of science.

The purpose of these committees may be outlined as follows:—

(1) To join in the preparation of the national census of research. This will be taken by the census committee of the Research Council, of which the chairmen of the various central committees are members.

(2) To prepare reports embodying comprehensive surveys of the larger possibilities of research in the various departments of pure science, suggesting important problems and favourable opportunities for investigation.

(3) To survey the economic and industrial problems of the United States, and report on possible means of aiding in their solution by the promotion of research in the fields represented by the various committees. (In co-operation with the council's committee on the promotion of industrial research.)

(4) To indicate how investigators in each committee's field can aid in the solution of research problems involved in strengthening the national defence. (In co-operation with the military committee of the National Research Council.)

(5) To point out opportunities, national and international, for co-operation in research, and to assist in the co-ordination of the various agencies already established for this purpose.

(6) To keep in touch with the research committees of educational institutions, and to supply research problems, suggestions, or thesis subjects when requested to do so.

(7) To serve as a national clearing-house of information regarding research problems in each committee's field which arise from scientific, industrial, and other sources, and are communicated to the council by local research committees or other agencies.

(8) To promote research by such other methods as may prove advisable, including the encouragement of such courses of instruction in educational institutions as are best adapted to develop greater breadth of view, a wider understanding of the methods of research, and a more general perception of the national importance of all forms of research, both in pure and applied science; the more effective use of existing research funds; the establishment of research fellowships, research professorships, and research endowments.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Prof. R. Saundby having resigned his post as professor of medicine in consequence of ill-health, the following resolution has been passed by the University Council: "That in accepting the resignation of Prof. Robert Saundby the council records its great regret that circumstances of health have rendered this step necessary. It desires to thank him for his long and distinguished services to the medical school in Mason College and the University, and takes this opportunity of expressing its appreciation of the invaluable assistance which he has rendered to medical education during the twelve years in which he has represented this University on the General Medical Council."

The work of Mr. John Humphreys, M.D.S., in connection with the Odontological Museum of the University of Birmingham has been acknowledged by the council in the following resolution: "That the council desires to express its keen appreciation of the ability, zeal, and generosity with which Mr. John Humphreys, M.D.S., has prosecuted for so many years the formation, in the University, of the Odontological Museum; and now that the catalogue of the specimens in the museum prepared by him has been published by the council, it takes the opportunity of congratulating him on the completion of the task. As a further mark of its gratitude to Mr. Humphreys for his life-

long devotion to the scientific side of dental education, so well illustrated by this unique collection, the council decides that the museum shall in future be named 'The John Humphreys Odontological Museum.'"

The family of the late Frederic Milward of Redditch has placed the sum of 1200*l.* in trust for the foundation of a scholarship to be known as the Frederic Milward Scholarship, which will be open to pupils on the registers of the county secondary schools of Redditch, and will be tenable at the University of Birmingham by students attending day courses in science, commerce, or engineering.

The Rev. P. S. Belton (a voluntary war-worker) has been appointed honorary assistant and demonstrator in the metallurgical department.

Miss B. M. Bristol has been appointed honorary assistant demonstrator in botany for the present term.

OXFORD.—All Souls College has come to the assistance of the University finances by devoting fifteen hundred pounds in aid of the general fund and the like sum to the purposes of the Bodleian Library. In the present depleted state of the University chest, owing to the war, these gifts are especially welcome.

On March 13 the form of statute establishing the degree of doctor of philosophy was passed by Congregation, and the statute was amended in certain particulars.

IN view of the value of the rabbit as food, the vice-chancellor of the University of London has given instructions that it shall not be used in practical examinations in zoology for science students or in general biology for medical students during the period of the war.

A READING from the poems of Sir Ronald Ross, K.C.B., F.R.S. (including the suite now appearing in the *Poetry Review*), will be given on Friday, March 23, at 3 p.m., at the house of Sir William Lever on Hampstead Heath. Sir Herbert Warren, K.C.V.O., will preside.

THE United States Department of the Interior has, says *Science*, designated Minnesota as one of the three States where mining experiment stations are to be established within a year. The Government will appropriate 5000*l.* annually for the support of such a station, and the State must supply the building. The regents have asked for 35,000*l.* for this purpose. There are to be ten such stations established eventually. Minnesota's importance as a mining centre has caused her to be selected as one of the first group.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 1.—Sir J. J. Thomson, president, in the chair.—Prof. W. E. **Dalby**: A graphical method of drawing trajectories for high-angle fire. A previous paper by the author, printed in Series A, vol. xcii., p. 239, explained a graphical method of finding the range, time of flight, angle of elevation, and other elements of a trajectory, from the data given by a curve showing the resistance of a standard shell in terms of the velocity. The graphical method followed the analytical method laid down in the military text-books. The paper dealt with direct fire, which is officially defined as "fire *under* angle of elevation 15°." The present paper is a continuation of the paper referred to above, adapting the graphical method to high-angle fire. For this the density of the atmosphere has to be brought into the calculation as one of the variables of the problem. Briefly, the method consists in applying the graphical method explained in the first paper in a series of steps, dealing in each step first with the vertical element of the trajectory and then with the corresponding horizontal element of the trajectory. The magnitude of a step is so selected that the influence of the change of tenuity on the resistance is negligibly small during the part of the trajectory corresponding to the step. The value of a quantity corresponding to, but not the same as, the ballistic coefficient in direct fire is changed from step to step to allow for the changing value of the tenuity as the shot moves in its trajectory. The method is applied to determine the trajectory of a shell weighing 380 lb., fired from a 9·2-in. gun elevated to 40°, taking the conditions of the shots fired during the Jubilee Trials in 1898.—Earl of **Berkeley**, E. G. J. **Hartley**, and C. V. **Burton**: Osmotic pressures derived from vapour pressure measurements.—Aqueous solutions of cane sugar and methyl glucoside. The paper forms a continuation of researches on the same subject already communicated to the society. If the ratio of the vapour pressure of a pure solvent to the vapour pressure of a solution is known, the osmotic pressure between the solution and the solvent can be theoretically calculated. Since the osmotic pressure is proportional to the logarithm of the ratio of the vapour pressures, a specially accurate determination of the value of the ratio is required in order to obtain good values for the osmotic pressure. The paper deals with the experimental arrangements for determining the vapour densities and the special precautions that have been taken to secure a high degree of accuracy. A number of corrections applicable to the simple theoretical formula have been examined, both experimentally and theoretically. The experimental results given refer to solutions of different degrees of concentration. The dissolved substances dealt with are cane-sugar and methyl glucoside and sulphuric acid, while the solvent in each case is water. The experiments were made at standard temperatures of 0° C. and 30° C.—W. **Wilson**: The complete photo-electric emission from the alloy of sodium and potassium. The subject of this investigation is the law governing the variation of the complete photo-electric emission with the temperature of the source of full radiation causing it. Theoretical considerations indicate that this law should be the same as that governing the temperature variation of the thermionic emission from hot bodies, namely, that expressed by the formula

$$C = AT^{\lambda}e^{-\frac{\phi}{2T}}$$

where T is now the temperature of the source of radiation, C is the photo-electric current per unit area of the emitting substance, A and ϕ are characteristic of the substance and independent of T, and λ is a small number, probably not differing much from 2. Experiments are described in which the alloy of sodium and potassium was exposed to approximately full radiation. A wide range of photo-electric currents and the corresponding temperatures of the radiator were measured, and the relation between them was found to be well expressed by the above formula.

Aristotelian Society, February 5.—Dr. H. Wildon Carr, president, in the chair.—F. C. **Bartlett**: Valuation and existence. Three important stages mark the development of the act of valuing. (i) The attitude of satisfaction, or of contentment, which is conditioned by readiness of apprehension and the presence of a feeling of ease. In this there is psychologically no element of direction upon an object, although, as a matter of fact, what is apprehended, the act of appre-

hending, and the feeling are all different. (ii) The stage of "liking," where what is apprehended begins to be distinguished from the apprehension and the feeling. In neither of these cases is there assertion or assumption of existence. (iii) We have finally the definite judgment forms: "This is beautiful, good, etc." With regard to the objects valued in these instances no consideration of existence or of reality is required in the æsthetic judgment; in judgments of economic value existence is probably indirectly assumed; the moral judgment assumes existence only if acts are to be considered as existing, for it is solely upon acts as performed that the moral judgment is passed. In every instance of its attribution it is required that there should be something possessing qualities and entering into relation with a subject. Thus, neither in the rudimentary attribution of value, nor in the developed value judgment, is anything of necessity assumed or asserted with respect to existence.

Geological Society, February 7.—Dr. Alfred Harker, president, in the chair.—C. T. **Trechmann**: The Trias of New Zealand. The fossiliferous Triassic rocks of New Zealand have been at different times attributed by New Zealand geologists to a Devonian, Permian, Permo-Carboniferous, Lower, Middle, or Upper Triassic, or Trias-Jura age. They are distinct from the Matai rocks, which contain a Permo-Carboniferous fauna. Triassic beds appear at intervals from Kawhia to Nugget Point—a distance of 620 miles. They are steeply inclined, and where they approach the Alpine chain of the South Island pass into semi-metamorphic greywackes or completely metamorphic phyllites and schists. In the North Island only the Noric and Rhætic horizons have been recognised. The Trias passes conformably up into Jurassic deposits. The lowest fossiliferous horizon of the Trias occurs near the top of a great thickness of greywackes, called the Kaihiku Series The Kaihiku fossils are scanty in species, and no cephalopods occur. The Kaihiku fossil horizon is either late Middle or early Upper Trias, and the great unfossiliferous series below it represents the Middle and possibly Lower Trias. The most highly fossiliferous division is the Carnic—the Oreti and Wairoa Series of New Zealand geologists. Several of the Carnic fossils show affinities with European Alpine forms. The Noric horizon, the Otapiri Series in part, is represented by felspathic sandstones. The Rhætic, the upper part of the Otapiri Series of local geologists, comprises a great thickness of sandy and pebbly beds. Forty-seven genera and species of molluscs and brachiopods are recorded, of which three genera and forty-one species are regarded as new. The affinities of the New Zealand Trias with that of the Malay Archipelago, and especially of New Caledonia, are discussed.—Dr. F. A. **Bather**: The Triassic crinoids from New Zealand collected by Mr. C. T. Trechmann. The specimens are all from the Kaihiku Series. Comparison of the three new species based on all these remains with the Triassic crinoids described from Europe, and especially with those from North America, leads to the conclusion that they are of Upper Triassic age. They bear, however, no resemblance to the Upper Triassic crinoids from Timor.—H. C. **Sargent**: A spilitic facies of Lower Carboniferous lava-flows in Derbyshire. The igneous rocks of Derbyshire form a basic series, consisting mainly of lavas and sills, hitherto classed as olivine-dolerites and basalts. All occur in Lower Carboniferous strata. The lavas were submarine and contemporaneous. Specimens of the lavas from certain localities exhibit a trachytic structure, and possess affinities with both spilites and mugearites. Field evidence shows that these spilitic rocks, as a rule, underlie the basalts. The whole series may have been derived from a common magma of normal basaltic type, and by the upward passage of gases through the magma a relative concentration of the alkalies took place in its upper part. It is suggested that the intense decomposition of the spilites is a case of auto-metamorphism, due to retention of volatile constituents resulting from the physical environment of a submarine flow. Since the spilites appear to be differentiates from a normal basaltic magma, it is concluded that they do not form a separate suite of igneous rocks distinct from other alkaline rocks.

Royal Anthropological Institute, February 27.—Major A. **O'Brien**: The criminal in the western Punjab. Crime is so excessive in the Punjab that if it were on the same scale here, there would be 1500 murders a year in the United Kingdom. The object of the paper was to determine how far the Punjab criminal is the outcome of his country's past history of internecine wars and how far of the present methods of administering law and order. A number of instances were quoted to show that at present the law, however majestic, is not very widely respected. The reasons for this state of affairs may be summarised as follows: The criminal code has not been adjusted with sufficient regard to the popular notion of what is criminal and what is not; the judicial system, supposed to have been modified to suit the country, is neither Oriental nor British, and falls between two stools; the official staff of judges, magistrates, police, and Crown counsel is quite inadequate to the work to be done. The Punjabi has adjusted himself to these conditions by taking infinite pains to fake his cases, which leads in return to his cases being viewed with the gravest suspicion. The innocent get convicted in a sufficient number of cases to encourage the policy of faking against enemies. The guilty get off too often scot-free. Thus there is a vicious circle of real crime, false accusations, acquittals, and more crimes in revenge for those unavenged judicially.

PARIS.

Academy of Sciences, January 22.—M. A. d'Arsonval in the chair.—The president announced the death of General Bassot, and gave a summary of his work.—G. **Bigourdan**: The first learned societies of Paris in the seventeenth century. The Academy of Montmor.—B. **Gambier**: The identity of Bézout.—M. **Petrovitch**: Value of the action along various trajectories.—M. **Mesnager**: A formula in simple series of the uniformly charged plate, fixed on a plane rectangular contour.—M. **Sauger**: The energy possessed by the earth from the fact of its rotation on itself. when for the density at its interior the law of variation $d=10\left(1-0{\cdot}76\,\frac{r^2}{R^2}\right)$ is assumed.—M. **Mazérès**: The location of foreign bodies by the X-rays without normal incidence and known height of bulb.—C. K. **Reiman**: Contribution to the revision of the atomic weight of bromine. The density of gaseous hydrogen bromide under reduced pressure. The known action of pure dry hydrogen bromide upon mercury excludes the direct measurement of the compressibility of the gas. It can, however, be determined indirectly by density measurements under different pressures. In the experiments described the gas was prepared by two methods: by direct synthesis from its elements, and by the interaction of potassium bromide and phosphoric acid. The final density leads to 79·924 as the atomic weight of bromine.—W. J. **Murray**: Remarks on the normal density of hydrobromic acid. Work carried out at Geneva on similar lines to that described in the preceding paper. The gas was prepared by the action of a limited quantity of water on

anhydrous aluminium bromide, followed by fractional distillation. The mean density found was 3·6440 grams per litre.—H. **Hubert**: Preliminary sketch of the geology of Senegal.—P. **Fallot**: The tectonic of Ibiza.—E. **Belot**: The satellite hypothesis and the orogenic problem.—H. **Devaux**: Cultural methods producing an increase in the production of wheat.—L. **Roule**: The larval and post-larval development of the fishes of the genus Mugil.—A. **Berthelot**: Researches on the production of phenol by micro-organisms. An organism, named *B. phenologenes*, has been isolated from the intestinal flora of man which is capable of producing about ten times as much phenol as the most active phenol-producing species hitherto known. With tyrosine as nutrient, a concentration of 800 mg. of phenol per litre is produced.—M. **Tonzes-Diacon**: The formation of turbidity in wine.—V. **Raymond** and J. **Parisot**: Trench feet. The authors give evidence that this condition is due to an infection by one or more moulds.

BOOKS RECEIVED.

Natural Health *versus* Artificial Health. By Satis Chandra Lahiri. Pp. vi+120 (Calcutta: J. Chandra Adhikari.) 8 annas

Science and the Nation: Essays by Cambridge Graduates, with an Introduction by the Rt. Hon. Lord Moulton Edited by A. C. Seward. Pp. xxii+328. (Cambridge: At the University Press.) 5*s*. net.

Kodak Bromide Pictures. By Some Who Make Them. Introduction by W. L. F. Wastell. Pp. 64. (London: Kodak, Ltd.)

The Principles of Plant-Teratology. By W. C. Worsdell. Vol. ii. Pp. xvi+296+26 plates. (London: Ray Society.)

Germany's Lost Colonial Empire and the Essentials of Reconstruction. By J. H. Harris. Pp. vii+88. (London: Simpkin and Co., Ltd.) 1*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—The Initial Wave Resistance of a Moving Surface Pressure: Prof. T. H. Havelock.—Experiments with Mercury Jets. (1) The Relation between the Jet-length and the Velocity of Efflux; (2) A Comparison with Jets of Other Liquids: Prof. S. W. J. Smith and H. Moss.—The Mode of Approach to Zero of the Coefficients of a Fourier Series: Prof. W. H. Young.—The Dissipation of Energy in the Tides in Connection with the Acceleration of the Moon's Mean Motion: R. O. Street.

ROYAL INSTITUTION, at 3.—Sponges: a Study in Evolutionary Biology: Prof. A. Dendy.

ROYAL SOCIETY OF ARTS, at 4.30.—The Industrial and Economic Development of Indian Forest Products: R. S. Pearson.

LINNEAN SOCIETY, at 5.—The Preparation of Plants for Exhibition: C. E. Jones.—A Systematic Study of the North American Melanthaceæ from the Genetic Standpoint: Dr. R. R. Gates.

FRIDAY, MARCH 16.

ROYAL INSTITUTION, at 5.30.—Scientific Forestry for the United Kingdom: Sir J. Stirling Maxwell.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Heat Treatment of Large Forgings: Sir W. Beardmore, Bart.—Heat Treatment of Steel Forgings: H. H. Ashdown.

SATURDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—Imperial Eugenics: Saving the Future: Dr. C. W. Saleeby.

MONDAY, MARCH 19.

ROYAL SOCIETY OF ARTS, at 4.30.—Memorials and Monuments: L. Weaver.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Palestine; its Resources and Suitability for Colonisation: Dr. E. W. G. Masterman.

VICTORIA INSTITUTE, at 4.30.—The Significance of the Geography of Palestine: Sir Charles Warren.

TUESDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Geological War Problems: Prof. J. W. Gregory.

ROYAL STATISTICAL SOCIETY, at 5.15.—How to Improve our Fishing Industries: The Right Hon. The Earl of Dunraven.

MINERALOGICAL SOCIETY, at 5.30.—The Basaltic Rocks of Spitsbergen and Franz Joseph Land in Relation to the Brito-Arctic Province: A. Holmes, with Analyses by Dr. H. F. Harwood.—A General Proof of the Limitation of the Symmetry-numbers of Crystals: Dr. J. W. Evans.—The Numerical Relation between Zones and Faces of a Polyhedron: Prof. E. S. Fedorov.—The Crystallisation of Parahopeite: A. Ledoux, T. L. Walker, and A. C. Wheatley.

ZOOLOGICAL SOCIETY, at 5.30.—The Prechordal Portion of the Chondrocranium of *Chimaera colliei*: E. Phelps Allis, jun.—A Sketch Classification of the Pre-Jurassic Tetrapod Vertebrates: D. M. S. Watson.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The New Electric Power-house at Birchills, Walsall: E. M. Lacey.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Sulphur in Petroleum Oils: Dr. F. Mollwo Perkin.

WEDNESDAY, MARCH 21.

ROYAL SOCIETY OF ARTS, at 4.30—Colour Printing, and Some Recent Developments: G. W. Jones.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Formation of Mist and Fog: Major G. I. Taylor.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Bateriology of War Wounds: Kenneth Goadby.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—*Probable Paper*: Observations and Experiments on the Susceptibility and Immunity of Rats towards Jensen's Rat Sarcoma: J. C. Mottram and Dr. S. Russ.

ROYAL INSTITUTION, at 3.—Modern Improvements in Telegraphy and Telephony: Prof. J. A. Fleming.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Modern Methods of Finding the Latitude with a Theodolite: Dr. J. Bell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Machine Switching Telephone Gear: F. R. McBerty.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 5.30.—Magic in Names: E. Clodd.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

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THURSDAY, MARCH 22, 1917.

MATHEMATICAL ANALYSIS.

(1) *Functions of a Complex Variable.* Being part 1 of vol. ii. By Prof. E. Goursat. Translated by Prof. E. R. Hedrick and O. Dunkel. Pp. x+259. (Chicago and London: Ginn and Co., 1916.) Price 11s. 6d.

(2) *Intégrales de Lebesgue. Fonctions d'Ensemble. Classes de Baire.* By C. de la Vallée Poussin. Pp. viii+151. (Paris: Gauthier-Villars et Cie, 1916.) Price 7 fr.

(3) *Functions of a Complex Variable.* By T. M. MacRobert. Pp. xiv+298. (London: Macmillan and Co., Ltd., 1917.) Price 12s. net.

(1) THIS is a competent translation of the last, substantially revised, edition of the original. Prof. Goursat needs no introduction to the mathematical public, so we content ourselves with directing attention to some of the features of this admirable course. The definition of "analytic function" coincides with Cauchy's definition of "fonction monogène"; the properties of such functions are developed with great lucidity, and the student is easily led on to such ideas as power-series, circles of convergence, Weierstrass's theory of analytic continuation, conformal representation, and so on. Riemann's surfaces are alluded to, but not discussed; the main outline follows Cauchy, and in this we think the author is judicious, because, however useful Riemann's surfaces are by their appeal to intuition, they are not easily realised by a beginner, and they have to be constructed in every special case by analytical methods.

Specially noteworthy is the way in which Prof. Goursat expounds some of the more recent discoveries and theorems, such as Weierstrass's factorial formulæ, Mittag-Leffler's theorem, functions with natural boundaries (such as Schwarzian functions), and so on. He has not only mastered these subjects, but is able to discuss them in an original and illuminating manner. For example, the brief discussion of Abel's theorem (pp. 244–50) brings out the essential point that if $R(x, y)$ is a rational function of x, y, and (x_i, y_i) is an intersection of two curves $\phi=0$, $\psi=0$, then the sum $\sum_i R(x_i, y_i)$, taken over all the intersections, is a rational function of the coefficients of ϕ, ψ. This is the real basis of Abel's theorem; all the rest is detail, which may be troublesome enough in any particular case.

There is a comparatively long section on elliptic functions; another on the application of them to curves of deficiency 1; Hermite's important theory of "cuts" is explained; and the last chapter is on functions of several variables. Altogether we could not wish for a better handbook for students of function-theory; it is clear, compact, and consistent; the references are to first-rate authorities, and sufficient to introduce the reader to the original sources. We are very glad that the methods of Cauchy and Hermite are given such prominence, because they are of permanent value, and only require some modifications of minor importance to bring them up to the current standard of rigour.

(2) Every now and then an advance in function-theory compels us to revise our notion of a definite integral. When the nature of Fourier series had been properly understood, Riemann generalised the definition of an integral so as to apply to them, and Dirichlet followed on the same lines. One of the main topics of the present course is a new definition of an integral (the Lebesgue integral) reducing, as the case may be, to the Riemann or the ordinary integral when it exists, but applicable to cases where both the previous definitions are at fault. Although brief, the course is so far self-contained that it ought to be intelligible to a reader who knows little or nothing about the theory of sets or that of transfinite numbers; the first section deals with measurable sets and their content, and the nature of Lebesgue integrals; the second with "additive functions of sets"; the third with Baire's classification of functions of sets. The last, so far as we can judge, is an important notion, more or less comparable with Hadamard's classification of whole functions (*mutatis mutandis*, of course), and adding one more to the family of "well-ordered classes" or sequences. Another point that cannot fail to strike the reader is the extraordinary difference between the properties of open and closed sets; this distinction is not a new one, but its importance is becoming more and more clear.

The author is sparing in his use of new symbols and technical terms; one, however, seems deserving of mention as being likely to be very convenient. If E is any set and E' its complement in the whole field considered, ϕ, *the characteristic function* (or characteristic) of E, is defined as being 1 for any element of E, and 0 for any element of E'. Much use is made of the theory of lattices, more or less in the manner of Minkowski. It is scarcely necessary to add that the author's treatment is original, even when dealing with the discoveries of others, and that he contributes much of his own invention.

Although not quite analogous to the problems of this course, we may give an easy example to show the kind of difficulties with which it deals. Take a real positive variable x, and define $f(x)$ to be 1 when x is rational, and 2 when x is irrational; then $f(x)$ is perfectly definite over any closed interval (a, b), but the integral of $f(x)$ from a to b does not exist, either in the ordinary sense or in that of Riemann, because $f(x)$ has finite oscillation within any interval δx, however small, and the discontinuities are crowded together. We have, however, an upper limit integral $2(b-a)$, and a lower limit integral $(b-a)$.

(3) Mr. MacRobert has written a book that is likely to be very useful; it is not too big, the selection of theorems is judicious, and there is a large number of really instructive examples, both

worked and unworked. Beginning with the ordinary definitions of complex numbers, etc., the author goes on to holomorphic functions, contour integration, and power-series; then we have Weierstrass's theory of infinite products, and after this various applications to gamma-functions and elliptic functions (both first-stage and second-stage). Finally, there are four chapters on linear differential equations, with applications to Legendre and Bessel functions. Singular points are considered after the manner of Cauchy; Weierstrass's theory of analytical continuation is explained; there is a good introduction to the work of Fuchs, Frobenius, etc., on linear differential equations; and the last chapter shows how to find solutions of $aw''+bw'+cw=0$ by means of definite integrals, with illustrations comprising Bessel functions and the hypergeometric series.

It is a small matter, perhaps, but we regret to see on p. 2 the formula $\tan\theta=y/x$ put in such a context that a beginner is apt to take it as a definition of $\operatorname{amp}(x+iy)$. The proper definition of the latter is that it is any angle satisfying the *two* relations $\cos\theta=x/r$, $\sin\theta=y/r$, where $r=|x+iy|=+\sqrt{(x^2+y^2)}$. No other definition meets the requirements of function-theory.

G. B. M.

PHYSICAL CHEMISTRY.

Theoretical Chemistry, from the Standpoint of Avogadro's Rule and Thermodynamics. By Prof. Walter Nernst. Revised in accordance with the seventh German edition by H. T. Tizard. Pp. xix+853. (London: Macmillan and Co., Ltd., 1916.) Price 15*s.* net.

THE fact that a fourth English edition of this treatise, based on the seventh German edition, has been called for is sufficient testimony, if any were still required, to the excellence of a work which has made for itself a high reputation for its individuality and lucidity. First published more than twenty years ago, the book was written from a definite point of view, emphasised in the title, owing to the belief of the author that "the theoretical treatment of chemical processes—the most important part of my task—depended, first, on the Rule of Avogadro, which seems to me an almost inexhaustible 'horn of plenty' for the molecular theory; and, secondly, on the Laws of Energy, which govern all natural processes." The position thus taken up by the author has become increasingly justified with time.

But although we give a glad welcome to this new edition of a valuable book, we cannot but feel some regret that certain sections should not have been made rather more modern, and that little or no attention should be given to some recent and valuable contributions to physico-chemical science. The translator frankly recognises that "the character of the work is slowly changing, since it is no longer possible in a book of this size to describe fully all modern developments of theoretical chemistry." This is quite true, but the reviewer cannot but feel that if the necessary trouble were taken, a certain amount of rearrangement of the matter would allow most of the important new developments to be at least indicated, if not fully treated. It must be regretted, for example, that in a book of this character no mention is made of the recent important work on X-ray spectra and the bearing of this on the atomic theory. Moreover, certain other sections, such as that on osmotic pressure, might with great advantage be rewritten (so far as the experimental work is concerned), in view of the investigations, in this particular field, of Morse and his collaborators, and of Lord Berkeley and E. G. J. Hartley. One table giving the results obtained by Morse and Frazer is reproduced, but it refers to some of the earlier work of these investigators carried out before their apparatus and technique had been perfected. In the case of this subject, moreover, the importance of which the author recognises, something more might be expected than the bare reference which is made to the work of Lord Berkeley and Mr. Hartley. (In passing, one may point out a misprint which seems to have gone through all editions of this work; namely, on p. 133, Flurin instead of Flusin. Likewise in the index.) Defects such as those indicated certainly diminish the value of the work for the general student, and the reviewer cannot regard as complete compensation the interesting treatment of Nernst's own researches, such as the sections dealing with the specific heat of solids and all that is based thereon, and the Nernst heat theorem.

Nevertheless, although there will always be a difference of opinion regarding the emphasis to be placed on the various sections of the subject, we cannot but recognise the success with which the author gives, in general, a survey of a very large and growing branch of knowledge; and this new edition of an inspiring and intellectually bracing book will doubtless receive the welcome it deserves. We ought also to express to the translator our appreciation of the general excellence of his work. Is, however, one may ask him, "depolarisators" (p. 778) an English word?

A. F.

OUR BOOKSHELF.

The Land and the Empire. By Christopher Turnor. Pp. 144. (London: John Murray, 1917.) Price 3*s.* 6*d.* net.

MR. TURNOR is well known as an enthusiastic landowner who firmly believes in the future of British agriculture if only it is properly taken in hand. He divides his book into three parts: the errors of the past; land settlement and education; and a sketch of an organised agricultural industry. The keynote to the whole is that a new outlook is wanted. On the rural side the Government, the landowners, and the farmers must all be brought to recognise that the holding of land implies the

duty of cultivating it in the best possible manner; on the urban side the people must realise that the country ought never again to be so dependent on sea-borne food as it has been during the past fifty years. Henceforth, Mr. Turnor urges, security of supply must be the motto, instead of a cheap supply at all hazards; and, lastly, the workers themselves must have a new outlook, and realise that salvation for our future economic troubles lies in unrestricted, and not in restricted, individual output.

Mr. Turnor argues his case extremely well, and drives home his arguments with numerous diagrams illustrative of his statistics.

One of the secondary effects of the war is that agriculture is fast becoming a controlled industry, and experiments in organisation are being tried now on a vastly larger scale than before. Already some of the suggestions of the reformers have been carried out. We have minimum prices; we shall soon have a minimum wage. The Game Laws have had a hole knocked through them, and in several directions the new conditions are advanced beyond the wildest dreams of 1914. We shall soon see how the new order is going to work, and in the meantime we can only welcome the fullest discussion of the agricultural problem as it is and as it seems likely to shape itself.

Morphology of Invertebrate Types. By Dr. A. Petrunkevitch. Pp. xiii+263. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net.

THIS volume is divided into twenty-eight chapters, each dealing with one type. Each chapter consists of a description of the systems of organs of a type and a series of instructions to be followed in the examination of the animal. Much importance is rightly attached to the drawings which the student is directed to make, and to do away with any tendency to copy the figures included in the book these are either diagrammatic or represent some related type. This latter device has here and there its disadvantages, *e.g.* the figures of Ankylostoma and Wilsonema are of relatively little use in aiding the student to understand the structure of Ascaris; there are too many differences between Ascaris and the types figured.

The descriptions are accurate, and on the whole well done, though some parts are too short, *e.g.* the accounts of the nephridia of the earthworm and of Nereis are inadequate. The types chosen are all found in America, except the Trematode *Dicrocoelium lanceatum* and the medicinal leech, but many of them occur also in Britain or are closely similar to British species, and the book will therefore be helpful to those "on this side" who desire an account of the general anatomy of such types as Pennaria, Sertularia, Tima, Aurelia, Dendrocœlum, Daphnia, a spider (Agelena), Asterias, Venus, Limax, Loligo, and Molgula. But in most laboratories in this country where similar types are studied, probably more attention is devoted to the finer structure of some of the organs, *e.g.* the nephridia cited above.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Horizontal Temperature Gradient and the Increase of Wind with Height.

IF the horizontal layers of air were isothermal (the upper layers having the lower temperature), then the gradient winds at different heights would be proportional to the temperatures (absolute) at those heights. Consequently the wind would decrease with height, and although a higher temperature at a given altitude over the higher pressure is a necessary corollary of an increase of wind with height, the converse is not necessarily true. It is clear on reflection that with such a temperature distribution as that described above, the temperature at any point in BD of Mr. Dines's diagram in NATURE of March 8 (p. 24) would be below the temperature at the corresponding point in AC, so that BD would be less than AC, and consequently v less than V; but the actual relation runs some risk of being obscured by Mr. Dines's use of isobaric surfaces which in other respects gives an admirably simple exposition of a theorem in atmospheric dynamics, and shows also that if the isobaric and isothermal surfaces coincide there is no variation of wind with height. Incidentally, during the past winter months the mean isotherms have run from N.W. to S.E., and have given at 6000 ft. a N.W. "thermal" wind of about 1½ metres per second superposed on the wind between 1000 and 1500 ft.

E. GOLD.

Meteorological Section, R.E., March 16.

A Fixed System of Grating Interference Bands.

I WISH to direct attention to a very remarkable property possessed by one of the systems of interference bands which make their appearance when white light is reflected from a plane replica-film grating, backed by a parallel silvered surface separated by a film of air. The appearance of the fringes in question is shown in the accompanying photograph, when the grating has 14,508 lines to the inch and the air-space is 0·0740 cm.

This system of bands, when examined by a spectrometer with a fixed collimator, remained *absolutely fixed* in the field of view of the telescope as the grating was rotated. This rotation has the effect only of moving the spectrum to and fro across the field of view without, in the least, altering the position of the dark fringes. This important property, which is uniquely exhibited by these fringes, seems to have escaped the notice of Prof. C. Barus, who has dealt with grating interferences and with their application to the displacement interferometry in a series of papers which appear in a collected form in the monograph "On the Production of Elliptic Interferences in Relation to Interferometry" (Carnegie Publication No. 149, 1911).

The fringes appear to be due to the interference between two portions of light arising out of the single beam incident on the grating, one of them being reflected at the silvered surface and then diffracted out by the grating element which it meets, and the other being diffracted into the air space by the same grating element and then reflected out by the silvered surface. The path difference is equal to

$$2t(\cos X - \cos \phi)$$

where ϕ and X are the angles of incidence and emergence respectively, and t the thickness of the air film. Therefore the condition for interference is

$$2t(\cos X - \cos \phi) = \frac{2K+1}{2}\lambda \quad . \quad . \quad . \quad . \quad (1)$$

where K is an integer.

But since we are using the grating, ϕ and X are connected by the relation

$$d(\sin \phi - \sin X) = n\lambda \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where d is the grating interval and n the order of the spectrum.

Hence, dividing (1) by (2), we have

$$\tan \frac{\phi + X}{2} = \frac{(2K+1)d}{4tn}$$

In this equation $(\phi + X)$ is the angle which the direction of any particular dark fringe makes with the incident light, *i.e* with the axis of the collimator. Since $(\phi + X)$ is determined once for all independent of the position of the grating, the absolute fixity of the fringes is accounted for. A detailed paper on this subject was laid before the session of the Indian Science Congress held at Bangalore in January, 1917.

C. K. VENKATA ROW.

6 Singarachari Street, Triplicane, Madras,
S. India, February 10.

Mountain Sickness.

THE reference in the Notes columns of NATURE of January 25 (p. 415) to the physical failure experienced in mountain-climbing at high altitudes sent me to the very instructive (and suggestive) article by Dr. A. M. Kellas in the *Geographical Journal*. And the great interest now attached to one of the inevitable problems of the immediate future gave me to think that a few supplementary notes might be of sufficient interest for publication. The "mountain sickness" which forms the association that specially interests the physiologist and the physician was impressively brought under the notice of the latter in the "fall" of the fifteenth century; when the gold-thirst of the ruthless Spanish invader of the western Eldorado made him familiar with its symptoms directly after reaching the very elevated backbone of the southern section of the New World. The oldest special description that appeared in print would seem to have been that of Da Costa; and the very human appetite for novelty proceeded very soon to make the "*mal de montagnes*" a phrase-name as familiar to Western Europe as that of the *mal français*—so very unhappily—rapidly came to be. The syndrome was referred to in the various linguistic territories bordering the giant Cordilleras as: *Soroche, mareo des Cordilleras, asthma des montagnes*, etc. And the native prophylactic, on the colossal slopes and towering cliffs of the Cordilleras of Peru, was slow and continuous mastication of prepared pellets of the dried juices of *Erythroxylon coca*—the original version of American "gum-chewing." The phenomena came in time to receive definite scientific discussion, notably at the hands of Bouguier ("Voyage en Peru") in 1745, and Condamine (of Peruvian bark fame) in 1751.

As world-wide scientific mountaineering developed—along lines of modern evolution—a number of French and German observers came to depict in turn their personal experiences of the symptom-group: Saussure, Clissold, Barry, Rohrdoff, Zumstein, Lepileur, Martins, and Bravais—according to their several personal experiences on Mont Blanc; Humboldt, Boussingault, and Hall—on the upper reaches of Chimborazo. As might be readily anticipated, in a personal experience in which individual constitution and previous training count for so much, we are told by the illustrious Humboldt that: "Ces phénomènes sont très-dissemblables suivant l'âge, la constitution, la finesse de la peau, les efforts antérieurs, les forces musculaires," etc. It very obviously corresponds in great, though not exclusive, measure to the "incommodités" of the *balloon* ascent of Biot and Gay-Lussac, on "le 6 fructidor, an XII" (August 24, 1804)—greatly exaggerated, of course, and developing at a lower altitude, from the very laborious *muscular exertion* of mountain-climbing. The latter rivals, as a factor in physiological derangement, the *suddenness* of change of environment in a balloon ascent, which bars off all chance of the gradual adaptation which would be so very necessary for functional adjustment.

JOHN KNOTT.

Dublin, March 2.

BORNEO AND ITS INHABITANTS.[1]

AS explained in the author's unfinished introduction, this book is a somewhat disconnected account of the natural history of Borneo, compiled from notes while he was in charge of the Rajah of Sarawak's museum at Kuching.

The first chapter deals with the mammals, and, as might be expected, considerable space is devoted to the orang-outang, or, as the author prefers to call it, the "Maias," this being its correct Malay name. It is satisfactory to learn that this interesting representative of the human family is still abundant, though local, in Sarawak. Though the fauna of Borneo is lacking in many of the larger mammals that appeal to the sportsman, it has at least its full share of remarkable forms among the smaller species. Many interesting details are given of that extraordinary little lemur, the Tarsier, *Tarsius spectrum*, and of the so-called flying lemur, *Galeopithecus volans*, that puzzle for systematists which has now the distinction of an Order to itself. The remarkable colour relationships between the squirrels of the island and certain unpalatable tree-shrews of the genus Tupaia are discussed at length. The relations of palm civets with coffee are at first sight far from obvious, but those of our readers who obtain their coffee from Borneo and are curious as to the previous history of the best quality berries should consult p. 33! It is of peculiar interest to find the mouse-deer taking the place in the native folk-lore of "Brer Rabbit," the latter itself being a direct descendant of the hare which always figures as the cunning hero in equatorial Africa.

The second, third, and fourth chapters are de-

[1] "A Naturalist in Borneo." By the late Robert W. C. Shelford. Edited, with a Biographical Introduction, by Prof. E. B. Poulton. Pp. xxvii+331+xxxii plates. (London: T. Fisher Unwin, Ltd., 1916.) Price 15s. net.

voted to birds, snakes, and other reptiles, and contain some excellent illustrations. Some account is given of the so-called "flying snakes," which, by rendering the ventral surface concave, are enabled to effect a sort of parachute descent from a moderate height. The author assists in dissipating the popular idea in this country as to the ubiquitous character of poisonous snakes in the tropics, since these do not, as a matter of fact, constitute a very large proportion of the snake population, and are seldom actually aggressive. An amusing account is given on p. 77 of the use of a stuffed python as a scarecrow for rats, though this would perhaps be scarcely suitable for adoption in this country.

FIG. 1.—Upper Sadong River at Tabekang. From "A Naturalist in Borneo."

The author was primarily an entomologist, and it is not surprising that the chapters on insects occupy rather more than one-third of the book. Especial attention is directed to the Orthoptera, more particularly the cockroaches, on which he was a recognised authority. It is not generally known that the common cockroach, *Blatta orientalis*, had invariably been found associated with human habitations until it was recorded a few years ago in the Crimea under leaves, stones, etc., in woods in a truly wild state. Many details are given of the striking coloration of various Mantids, especially of those which are floral simulators and are thus a living trap for butterflies and other flower-frequenting insects. In the chapter on beetles some good figures are given of the remark-

FIG. 2.—The Bornean Lemur, the Tarsier, *Tarsius spectrum*. From "A Naturalist in Borneo."

able "Trilobite" larvæ of what is presumed to be a very large, unidentified Malacoderm. The importance and overwhelming number of ants in the tropics, with a detailed account of their complex relations with plants, occupy another chapter. In the author's view the supposed benefits obtained by so-called myrmecophilous plants have been exaggerated, and the wonderful development of plant forms in this relation should be regarded more as protective devices than for the purpose of attraction. A whole chapter is devoted to mimicry, of which theory the author was a strong supporter, as indeed might be expected in one who had much experience of the tropics. In this connection a valuable list is given of the Bornean Longicorns mimicking Hymenoptera and other Coleoptera.

The later chapters are devoted to an attractive account of expeditions into the interior, the fauna of the seashore, and some notes on the manners and customs of the natives, while a number of explanatory notes by Prof. Poulton and others form an appendix.

The book is well printed and has a useful index, while the excellent illustrations are mainly from the author's own photographs. Though much has been done by its distinguished editor to combine it into a more or less connected whole, it is greatly to be regretted that its author's untimely death necessarily renders it less complete than we could have wished. It will, nevertheless, be found most fascinating reading by all lovers of Nature.

THE FLOTATION METHOD OF ORE CONCENTRATION.

THE recovery of metalliferous minerals from crude ores in the condition of cleanliness necessary for metallurgical operations is accomplished by the removal of the non-metalliferous material, leaving the valuable minerals in a concentrated condition. In this removal advantage is chiefly taken of the higher specific gravity of the metalliferous material, which permits its separation either when falling vertically in still water or when travelling horizontally in moving water. This is known as water- or gravity-concentration; it depends upon the differential movement of heavy and light minerals in water.

Other properties are also at times made use of in effecting this removal, such, for example, as magnetism in magnetic separation, and electric conductivity in electrostatic separation. These secondary methods have, however, found their application almost exclusively in the separation of the individual minerals of a complex concentrate already recovered by water concentration, and the fact remains that, outside exceptional cases, gravity-concentration has been practically the one means of removing the waste material from crude ore.

This means has well-defined and inexorable limitations. When the ore has to be crushed fine in order to release the individual grains, some of it unavoidably becomes rendered so impalpably fine that all advantage of gravity becomes lost in the greater factor of the water's resistance, and no differential movement is any longer possible. Gravity-concentration also demands for its success that there shall be a sufficient difference in gravity between the mineral to be recovered and that to be removed. In cases where that difference does not exist, and such are continually occurring, it fails.

These limitations have until comparatively recently been accepted as in the nature of things. If not in the mechanical preparation of ores, there was in the hydro-metallurgical processes of recovery the compensating factor of remarkable progress. The advent of cyanidation in 1889 had gradually effected a revolution in the recovery of gold and silver. In this process no removal of the worthless material was necessary, since the active solutions themselves made the necessary discrimination, attacking only the valuable mineral and leaving the mechanical preparation responsible simply for crushing the crude ore to the necessary fineness.

In the case of the base metals the position was not so satisfactory. The greatly increased consumption of these metals necessitated attention to the more complex and poorer deposits. Among them, opportunely, was the immense Broken Hill deposit containing argentiferous lead and zinc ores in a heavy matrix. By gravity-concentration it was possible to market only about 60 per cent. of the lead, and less of the silver, leaving the bulk of the zinc associated with the heavy waste as a middle product, while the finest and lightest portion of the crushed material was often allowed to flow away.

The quantities concerned were, however, so enormous that every process possessing any possible chance was tried, with in almost every case little success. Among them, however, was one which took advantage of the property possessed by metallic sulphides when in a fine condition to float, and therefore known as the flotation process. When, for instance, a mixture of such sulphides and waste in a fine condition is gently brought on to the surface of moving water, it will be found that the waste particles will break through that surface and sink, whereas the sulphides will float away. Further, this differential behaviour will be the more pronounced if in one way or another the sulphide particles can be oiled or greased. This, providentially enough, can readily be done because of a second property possessed by sulphide particles, that of adsorbing oil when agitated with a small proportion of oil in an aqueous mixture, a property which the particles of waste do not possess. This effect of an oiled or greased surface will be appreciated from the comparative ease with which a small needle which has been passed through the fingers can be made to float, whereas it would be very difficult indeed to get the same needle to float after it had been cleaned in the flame or by alcohol.

In this oiled condition the floating powers of sulphides are so reinforced that what otherwise might be an inadequate separation is then generally highly satisfactory. The air, and not the oil,

is, however, the prime factor, and the reason the sulphide particles float is because of the air-film attached to them and not because of oil buoyancy. Accordingly, though a small amount of oil is generally used, flotation may be, and in particular cases is, achieved without oil. Nor is it necessary to bring the mixture gently on to the water surface; the sulphide particles, if introduced below the surface, will attach themselves to air-bubbles introduced at the same time, and rise. This result is probably more readily completed if enough oil is present to cover the sulphides with the filmiest covering of oil, though an excess of oil would agglomerate such particles and cause them to sink. Be that as it may, it is considered that the particular function of the oil is to lower the surface tension of the water and so permit the mineral-laden bubbles to form a froth which is the stronger both because of the presence of the oil and because of the strengthening effect of the mineral particles themselves; in this latter connection the retention of the globular form by drops of water thrown on to a dusty floor is interesting. When thus assembled into a froth the collection of separated sulphides is easy.

Two main theories have been put forward to explain flotation. The first, and probably the most applicable, is that of interfacial tensions between the different phases, sulphide particle, air-bubble, water, and sometimes oil droplet. This was suggested by the difficulty of wetting sulphides. It is conceivable that the sulphide surface has a potentiality to oxidise or otherwise change its chemical state, and for that reason to stick to an air-bubble when brought in contact with one; whereas the oxides, carbonates, and silicates of the worthless material, having nothing to get from the air, are inert. Flotation may then for convenience be said to depend upon the surface energy of mineral particles, just as magnetic separation is dependent upon their magnetism.

The second theory, and one of great assistance as a working hypothesis, is based on the fact that mineral particles in water, by reason of the film around them, are electrically charged, the sulphide particles positively and the non-metalliferous particles and air-bubbles negatively. Under these conditions the attachment of the sulphide particles to the air-bubbles is readily understood; air being a non-conductor, discharge would not come with contact.

In addition to oil, sulphuric acid is also generally used. Its effect is to increase the wetting powers of the water, so that less of the waste is entrained with the sulphides and the concentrate consequently cleaner. Whether the view be taken that the acid achieves this effect simply by cleaning the surfaces, or by acting as an electrolyte, largely depends upon what theory is being applied. If carbonates be present in the ore, an additional effect of the acid is that the generation of carbonic acid gas may render the special introduction of air unnecessary, since experience has shown that bubbles of this gas may take the place of air.

Whatever the true theory, it is impossible to question the fact of the great importance of flotation concentration. Its success upon the zinc middling product at Broken Hill was immediate. At first, in 1900, used only for treating a sandy material, with the elimination of imperfections and the introduction of improvements it eventually became applied to the slime, the position now being that the whole range of zinc products on that field is treated by flotation, and zinc ore to the extent of about 500,000 tons per year is being recovered.

Such a success could not be without influence upon the recovery of fine material elsewhere, and at this time the large disseminated copper deposits of America were becoming big producers of copper. With these low-grade deposits ordinary gravity-concentration was yielding at most, even with an extensive plant, a 70 per cent. recovery of the contained copper, the larger part of the loss being in the very fine material. Upon this material flotation tests showed a much better recovery, and many plants have now been provided with a flotation equipment to treat this fine material, bringing the total recovery of the copper up to about 85 per cent. One large mine, having a capacity of several thousand tons a day, has indeed gone to the extent of making flotation the prime concentration process employed, in spite of the fact that a gravity-concentration plant had been designed and was about to be put into execution.

Lead ores in their turn have had this process applied to their finer material, to the much-improved recovery of the lead contents; while simple zinc ores have similarly benefited. Flotation has also in some cases been applied to the beneficiation of the fine sulphides of silver and the tellurides of gold, encroaching in these cases upon a field long the monopoly of the cyanide process; while among the ores of the minor metals, molybdenite, the sulphide of molybdenum, except for what can be done by hand-picking, is entirely recovered this way.

Finally, it may be said that though Australia led the way, there is scarcely a metalliferous district in the world where flotation has not become a factor of the greatest interest, while its advent has been to the base metals the same beneficent revolution that the cyanide process was to the precious metals.

It is a pleasure to know that this process, like the cyanide process, was largely the discovery of British experimentalists, and in connection with it the names of Elmore, Sulman, and others will become historical. The only regret is that it should have been the subject of so much litigation and the source of so much animosity.

MAJOR SYDNEY D. ROWLAND.

WE regret to announce the death on March 6, in France, from cerebro-spinal fever, of Major Sydney Donville Rowland, R.A.M.C., M.R.C.S.

Sydney Rowland was born in 1872 and educated at Berkhamsted School, whence he pro-

ceeded in 1889 to Cambridge with a science scholarship at Downing College. At Cambridge he took the Natural Science Tripos and was for a short time assistant demonstrator in the Physiological School. Whilst at Cambridge he was a prominent member of the Cambridge Natural History Society and some time its president. At this time he was keenly interested in almost every department of natural science and philosophy. As a friend who was his contemporary has expressed it, he was an amateur of science in the best sense of that word.

After leaving Cambridge Rowland came to London and completed his medical studies at St. Bartholomew's Hospital. At the end of 1898 he received an appointment which afforded him scope for his particular gifts, namely, that of assistant bacteriologist at the Lister Institute, and he remained a member of its staff until his death. Henceforth he was able to devote the whole of his time to scientific investigation.

Rowland was an extraordinarily good mechanic, and his ingenuity and skill were at all times at the service of his colleagues. The conquest of technical difficulties was a pure joy to him, and he was even sometimes in danger of letting it assume the importance of an end in itself. He early became an excellent microscopist, and ultimately acquired an unusually perfect command of all the applications of what he used to term "glass and brass."

His earlier researches were concerned with the structure of bacteria and the study of various enzymes which Hedin and he discovered in the expressed juices of animal cells. The next important piece of work upon which he was engaged was carried out in conjunction with the late Dr. MacFadyen. The latter having ascertained that bacteria survived the temperature of liquid air, it occurred to him and Rowland that grinding up bacteria at this low temperature would afford a cell-juice much more nearly resembling the composition of living bacteria than had hitherto been possible to attain, and they hoped that the injection of bacterial cell-juices, so obtained, into animals might afford curative sera for typhoid and other diseases. The research was a lengthy one, and the technical difficulties to be overcome very considerable. The latter were ultimately conquered by Rowland, but the result was disappointing, and the main object was not attained.

Rowland was a member of the Commission for the Investigation of Plague in India and worked at Bombay during 1905 and 1906. He took an active part in establishing the dependence of the human epidemic of plague upon the rat epizootic and the importance of the rat flea in the spread of the disease.

On his return to England he worked upon problems in plague immunity, principally with a view to the improvement of methods of prophylactic inoculation, and published a number of important papers on this subject. He was still occupied in this work when, in October, 1914, he obtained a commission in the R.A.M.C. and proceeded to France in charge of No. 1 Mobile Laboratory. He was recently engaged in discovering meningococcus "carriers" amongst troops and contracted the disease himself.

Rowland had an original and versatile mind and was interested in almost all departments of scientific activity. He was somewhat erratic, but a faithful friend, whose spontaneous gaiety and generous sympathy endeared him to all those who knew him intimately. C. J. M.

NOTES.

It is officially announced that Mr. A. D. Hall has been appointed Permanent Secretary to the Board of Agriculture in succession to Sir Sydney Olivier, K.C.M.G., now resigned. Sir Sydney has made many friends at the various agricultural colleges and research institutions, and his term of office has been marked by a kindly and sympathetic consideration of all matters relating to the application of science to agriculture. He carries with him into a well-earned retirement the good wishes of all those with whom he was brought into contact. The agricultural teachers and advisers, and the workers at the agricultural institutions generally, greatly appreciated his sincerity and his obvious desire to help British agriculture in every way possible. During his term of office the Board of Agriculture has considerably expanded, and is now larger than ever before. Mr. Hall's appointment as Sir Sydney's successor will be welcomed everywhere, and will be taken as an earnest that still further developments are contemplated. Mr. Hall has recently put forward his ideas in his book, "Agriculture after the War," in which he sets out a coherent plan for the development of British agriculture on sound scientific lines. Several of the recommendations have since been adopted, and there can be little doubt that the war period will furnish experience of special measures which will be invaluable in the reconstruction after the war. Thus Mr. Hall starts in his new office at an opportune moment for further developments. At the same time it must be admitted that in many respects the situation is bad; some egregious blundering on the part of War Office officials in their dealings with agriculturists has recently come to light, and has caused serious misgivings among farmers. Mr. Hall has the hearty good wishes of everyone in the attempts he will doubtless make to straighten out the tangle.

When the establishment of a separate Department of Scientific and Industrial Research was announced in December last, Lord Crewe stated that the Chancellor of the Exchequer was prepared to advise the Government to devote a sufficient sum to cover operations during the next five years on a scale which would provide four, or perhaps five, times as much for co-operative industrial research as had been spent for the whole purposes of research hitherto. The Civil Service Estimates just issued include the sum of 1,038,050*l.* to the Department of Scientific and Industrial Research, being a net increase of 998,050*l.* upon last year's amount. Grants for investigations carried out by learned and scientific societies, etc., are estimated at 24,000*l.*, and grants to students and other persons engaged in research at 6000*l.* These grants will be distributed by a committee of the Privy Council, on the recommendation of the Advisory Council, to promote the development of scientific and industrial research in the United Kingdom, and will be subject to such conditions as the committee may

think necessary. The 1,000,000*l.* grant in aid of industrial research will be paid to the account of the Imperial Trust for the encouragement of scientific and industrial research. The expenditure of the trust will be audited by the Comptroller and Auditor-General, but any balance remaining on the account will not be surrendered at the close of the financial year. Grants will be made by the directions of the Committee of the Privy Council over an agreed period to approved trade associations for research, to supplement the funds of the associations, and payments in respect of such grants will not be liable to surrender by the grantees at the end of the financial year. We understood from Lord Crewe's remarks on December 1 that for the next five years or so about 200,000*l.* a year would be available for scientific and industrial research, so that apparently the grant of 1,000,000*l.* is the sum which is to be drawn upon for this purpose. The amount estimated for salaries, wages, and allowances in the new department is 7250*l.*, which includes 1500*l.* for the secretary and 850*l.* for the assistant secretary. Travelling and incidental expenses are estimated to amount to 800*l.*

PROF. C. S. SHERRINGTON, Waynflete professor of physiology in the University of Oxford, has been elected a corresponding member of the R. Accademia delle Scienze of Bologna.

ON Thursday next, March 29, at 3 p.m., the president of the Royal Society will unveil the memorial to Sir William and Lady Huggins in St. Paul's Cathedral. Addresses will be given by the president, and by the president of the Royal Astronomical Society.

THE annual general meeting of the Chemical Society will be held at Burlington House on Thursday, March 29, at 4 p.m., when a ballot for the election of officers and council for 1917–18 will be held, and Dr. Alexander Scott, the retiring president, will deliver an address entitled "The Atomic Theory."

THE death is announced, in his sixty-eighth year, of Dr. E. D. Peters, professor of metallurgy at Harvard University and the Massachusetts Institute of Technology since 1904. He was the author of standard works on copper smelting, as well as of many technical monographs.

DR. W. C. ALPERS, dean of the School of Pharmacy at Western Reserve University, Cleveland, has died in that city at the age of sixty-six. He was a native of Hanover, and studied at Göttingen. In 1914 he was elected president of the American Pharmaceutical Association. He was a member of the revision committee of the U.S. Pharmacopœia, and the author of volumes on "The Medicinal Plants of Staten Island" and "The Pharmacist at Work."

ATTEMPTS have recently been made to work coal on the island of Bornholm, in the southern Baltic. No Carboniferous rocks are exposed, since apparently they have been cut out by the faults that have brought Rhætic, Lias, and later rocks against the older Palæozoics. Traces of coal have, however, been found by boring, but the attempts referred to have now shown that any workable layers lie at such a depth that their exploitation is not a paying proposition.

THE council of the Incorporated Municipal Electric Association, recognising the important part that electricity may be made to play in the better cultivation and greater production of the land and in the extension of rural industries, has formed the nucleus of what is ultimately intended to be a committee representative of all interests with the object of a thorough investigation into the technical and commercial problems underlying the application of electrical energy for such purposes. The chairman of the committee is Mr. S. E. Britton, City Electrical Engineer, of Chester, and among the objects are:—(1) To investigate and advise upon the problems underlying the supply and use of electrical energy in agricultural areas for power, lighting, heating, culture, and other purposes for farms, villages, and rural industries. (2) To collect and collate information, and publish literature bearing upon the above. (3) To co-operate with agricultural and other associations. (4) To investigate in co-operation with manufacturers the development, manufacture, and adaptation of agricultural machinery, and appliances for utilising electrical energy.

THE Royal Geographical Society announces that the King has approved of the award of the Royal Medals for the present year as follows:—Founder's Medal to Commander D. G. Hogarth, R.N.V.R., for his explorations and other geographical work in Asiatic Turkey, 1887–1911; Patron's Medal to Brig.-Gen. Rawling, C.M.G., for his explorations in western Tibet and Rudok, 1903, his journey from Gyantse to Simla *viâ* Gartok, 1904, and his explorations in New Guinea, 1908; Victoria Medal is awarded to Dr. J. Scott Keltie for his eminent services to geography during his secretaryship of the society. The other awards are:—Murchison Grant to Rai Bahadur Lal Singh for his devoted work as surveyor to the expedition of Sir Aurel Stein; Back Grant to the Rev. Walter Weston for his travels and explorations in the Japanese Alps—a district previously unknown to Europeans; Cuthbert Peak Grant to Dr. A. M. Kellas for his exploration and ascent of new peaks in Sikkim, and his investigation of the effects of high altitude; Gill Memorial to Mr. E. C. Wilton for his geographical work in south-western China.

THE Advisory Committee for Aeronautics has appointed a Light Alloys Sub-Committee. The members of the sub-committee are Mr. Henry Fowler, superintendent of the Royal Aircraft Factory (chairman), Lieut.-Commander C. F. Jenkin, R.N.V.R., and Prof. F. C. Lea, representing the Air Board; and Capt. H. P. Philpot, Mr. A. W. Johns, and Dr. W. Rosenhain, representing respectively the Aeronautical Inspection Department, the Director of Naval Construction, Admiralty, and the National Physical Laboratory; together with the chairman of the Advisory Committee for Aeronautics, *ex officio*. The functions of this sub-committee will be to advise Government Departments on questions relating to light alloys, to institute research for the development and improvement of such alloys and the methods of working them, and to assist in the removal of difficulties which may arise in their production and use. It will be in close touch with the experimental work on light alloys which is being carried out at the National Physical Laboratory, the Royal Aircraft Factory, the University of Birmingham, and elsewhere, and hopes to be able to give advice and assistance to manufacturers undertaking the production of light alloys and to founders engaged in the manufacture of engine parts, cylinders, pistons, crank cases, etc.

AT the first ordinary meeting of the Refractory Materials Section of the Ceramic Society, held at Leeds University, it was stated that the remarkable properties of zirconia make it an admirable refractory. Even the natural crude zirconia is well adapted for use in electrical furnaces and in other cases where exceptionally strong heat has to be resisted. In Germany it was

used for various purposes, and before the war was sold at prices ranging from about 31*l.* to about 50*l.* per ton, according to the degree of purity. Podszus proposes to make refractory ware of fused zirconia, burning at 2300°–2400° C. in a furnace made chiefly of fused zirconia, using coal-gas, petroleum, or acetylene, first with air-blast and finally with oxygen-blast. Ruff and Lauschke found the melting point of pure zirconia to be 2563° ± 10° C., and that addition of small proportions of alumina (1 per cent.), thoria (1 per cent.), or yttria (1 to 3 per cent.) was beneficial when burning zirconia up to 2000°, 2200°, or 2400° C. respectively. Dr. J. W. Mellor ascribed the spalling of magnesite bricks to two main causes: the shrinkage resulting from the change of calcined magnesite from a form having a lower specific gravity to a form with a higher specific gravity, and the shrinkage caused by the closing of the pores on heating. The feasibility of setting up a definite standard was asserted. Prof. J. W. Cobb, referring to methods of control for the temperature-time-atmosphere effects, said he had found it necessary to make Seger cones considerably larger, so that they might be easily visible in position and better able to withstand accidental heat-waves. He also found it advantageous to modify the shape, so as to give an edge instead of a point above. He hoped that now they are being made in England their disadvantages will not be perpetuated.

THE death of Mr. Baldwin Latham at the advanced age of eighty removes a notable link with the engineering profession in Victorian days. A generation ago Mr. Latham was in the forefront of practising civil engineers, and was widely known and respected as an authority on all matters connected with the science of sanitation. He was twice president of the Royal Meteorological Society and president of several other scientific societies, as well as twice Master of the Playing Card Makers' Company. His book on sanitary engineering, first published in 1873, speedily obtained recognition as a standard work, and was awarded a diploma of honour at the Health Exhibition of 1884. In the course of his practice, Mr. Latham was commissioned to prepare a great number of reports on schemes of water supply and sanitation for various localities. In Great Britain he actually carried into execution more than one hundred such works, in addition to advising on a great many more. Abroad, he designed and constructed water-supply and sewage-disposal works for Calcutta, Bombay, Ahmedabad, and other Indian cities, and he also prepared a scheme for Cairo. He was a great authority on underground water, and carried out extensive hydro-geological surveys. By the knowledge he acquired, he was enabled to forecast the outbreaks of the Croydon Bourne, which in some years flows down the Caterham Valley.

BY the death on March 3 of Mr. A. E. Gibbs, at fifty-eight years of age, St. Albans has lost one of its most esteemed citizens, and science an able and assiduous naturalist. Although engaged in business as a printer and part proprietor of the *Herts Advertiser* and the *Luton News*, Mr. Gibbs took an active part in all local educational matters, having been honorary secretary of the School of Science and Art, a member of the Education and Public Library Committees, and one of the founders of the new High School for Girls, and also of the Hertfordshire County Museum, of which he was a secretary and the curator of the natural history and numismatic collections, to each of which, and also to the archæological collection, he contributed largely. Commencing his scientific studies with geology, he early turned his attention to botany, especially cryptogamic, but lately he had chiefly devoted his energies to entomology, collecting Lepidoptera and other insects, not only in this country, but also on the continent of Europe and in northern Africa. He was a fellow of the Linnean, Zoological, Entomological, and Royal Horticultural Societies, and when he died was near the end of his two years' term of office as president of the Hertfordshire Natural History Society, his last publication, one of many papers he contributed to the society, being a presidential address on the "Satyrid Butterflies of Hertfordshire," illustrated by a coloured plate of *Pararge aegeria* and its varieties.

IT is with deep regret that we record the death, at the age of seventy-one, of Charles Achille Muntz, the distinguished French agricultural chemist, who was well known for his investigations on air, soil, and agricultural products generally. Muntz was of Alsatian birth, and began his scientific career as "préparateur" for Boussingault at the Conservatoire des Arts-et-Métiers, by whom he was attracted to agricultural chemistry. His first important work was done in connection with Schloessing in 1878, and formed a simple yet striking investigation, which at once attracted world-wide attention and has since led to remarkable developments. It had long been known that nitrates are formed in soil from nitrogenous organic compounds, and the reaction was proved to be of the highest agricultural importance. But the mechanism of the change was unknown; neither chemical nor physical causes seemed to account for it, and no other agent was suspected. Schloessing and Muntz began by measuring the amount of nitrification taking place when dilute sewage was allowed to trickle down a tube packed with chalk; they found that no action occurred for twenty-one days, but then it suddenly set in. Why, they asked, was this delay? If the process were chemical or physical, it should set in at once; the only explanation appeared to be that it was biological, the period of delay being the time needed for the multiplication of the organisms. This hypothesis was tested by adding a little chloroform; the process at once stopped; it was started again, however, when the chloroform was removed and some soil extract added. Although Muntz did not proceed further with the work, others took it up, and it led to the establishment of a new branch of science—soil bacteriology. Some years afterwards he showed how nitrification might be intensified so as to give a commercial source of nitrate if necessary; but subsequent electrical developments have probably displaced biological methods on the large scale. His other investigations, if they attracted less attention, were no less meritorious; he did good work on the chemistry of the atmosphere, determining its content of ammonia and nitric acid, and demonstrating also the presence of alcohol. His other chemical work dealt with mannite and other sugars, and with the nutrition of animals; finally, mention must be made of his admirable book on manures.

IN the March issue of *Man* Prof. C. G. Seligman discusses a series of canoe prow ornaments from Netherlands New Guinea. The occurrence of representations of birds in these carvings suggests that the natives of this region may have totem birds. It is remarkable that ornaments of this type do not seem to occur in British New Guinea west of Cape Nelson promontory. The suggestion is made that the Humboldt Bay ornaments represent the more archaic form which became modified in the Massim area by the influence of a foreign culture, Polynesian or Melanesian, of which there is abundant evidence in that district. "In other words, while the basic idea of the ornament remained unaltered, a people

who may almost be said to have 'seen' in curves (if not in spirals) succeeded in imposing their idea of representation upon the simpler animal forms of the folk with whom they mixed."

THE Journal of the Royal Society of Antiquarians of Ireland (vol. xlvi., part ii., for December, 1916) contains two important contributions on Irish antiquities. Mr. T. J. Westropp continues his survey of ancient forts and dolmens in western Ireland with an account of those in Inagh and Killeimer, County Clare, in which a number of hitherto unknown buildings are described. Mr. J. P. Condon has carried out a similar survey of rude stone monuments in the northern portion of Cork County, in which he extends and brings up to date the catalogue of these erections made by Borlase in his "Dolmens of Ireland" and by other writers. Much destruction has taken place since the holdings have fallen into the hands of the peasant proprietary, and it is well that these interesting antiquities should be carefully described before it is too late.

THE *Psychological Bulletin* (vol. xiv., No. 1) contains an article by C. S. Berry on the effect of smoking on the speed and accuracy of adding figures. Each evening, half-an-hour after dinner, the writer added one hundred figures arranged in ten columns of ten figures each, the length of time taken to perform the operation being noted and also the number of errors. On alternate evenings he had smoked one cigar immediately before performing the test, and he kept records for twenty days. The results of the experiment, according to the author, are at variance with those of other investigators, giving, contrary to his expectation, an improvement of 7·7 per cent. in the time taken on the "smoking" days; the differences in the number of errors made were so slight as to be negligible. The author, however, does not say whether, prior to beginning the investigation, he had had sufficient experience of the test to have overcome the effect of practice, nor does he give the daily variations for a similar length of time under normal conditions. It is necessary to have had an extended series of normal records preceding a drug investigation before it can be confidently affirmed that the differences, if any, are true drug effects. Ordinary normal variations are surprisingly great for many tests, and particularly so for intellectual operations. The present article may serve, however, to stimulate further inquiry.

A CURIOUS human abnormality—the "Hereditary Absence of Phalanges through Five Generations"—is described by Dr. E. Cragg and Dr. H. Drinkwater in the *Journal of Genetics* for December (vol. vi., No. 2). This condition is more extreme than that known as "brachydactyly," since each digit—excepting the thumb and great toe—has only one phalanx and no nail. The deformity of the fingers behaves in some respects as a Mendelian dominant, but more than half the offspring in marriages between affected and normal persons are affected. The thumbs of these abnormal individuals are often flattened, and perhaps show a tendency to bifurcation.

THE New Zealand Defence Department has issued a practical pamphlet on fly-control in military camps, written by Prof. H. B. Kirk, of University College, Wellington. He has found that the breeding of flies in latrine-trenches may be stopped by ramming the earth hard; while spraying latrine-pans with light oil, or with a dilute solution of arsenic and sugar, kills very many flies. Wires coated with "tangle-foot" are found efficient for catching flies in rooms; vertical wires from a foot to three feet long are best, "suspended from a horizontal wire or from any chance support." An ingenious plan for trapping flies that may gain access to garbage-bins is described. Many ways of treating horse-dung for the destruction of maggots are suggested, such as spraying with 1 per cent. arsenical sheep-dip in sweetened water, or pegging tarpaulin or sacking along the base of stacks to prevent the insects from escaping.

IN view of the considerable extension of our arable area which is foreshadowed, the problem of the production and dissemination of improved varieties of agricultural seeds acquires still greater importance than has yet been attached to it in this country. According to a writer in the *Journal of the Board of Agriculture* (February, p. 1081), the introduction of "Plumage" barley alone has probably added at least 250,000*l.* to the value of the barley crop in this country. The lines upon which improvement must be carried out have now been fairly well defined, and the time would appear ripe for the development of a national organisation for the production and control of improved seed supplies. The writer of the article suggests that the desired end can only be secured by means of a Seed Control Agency, to be administered in association with the research institutes concerned with plant-breeding, and supported, if necessary, by the State. The agency should serve as a centre of distribution, not only of new and improved varieties of seeds, but also of guaranteed "pure" stocks of the established varieties of proved merit. A brief account is given of the work done on these lines and the results achieved, at Svalöf, in Sweden.

A GOOD representation of the weather for London is obtained from the Greenwich meteorological observations, and these also show generally the weather conditions over England. The long series of observations affords a trustworthy comparison with past years. Observations for the past winter, December to February, are taken from the results published in the daily weather reports of the Meteorological Office. The mean temperature for each of the three months was below the average, the greatest deficiency being 4·6° Fahr. in February, and the mean for the whole winter was 3·4° below the normal. The mean winter temperature, 35·9°, was 7° colder than the preceding winter, 1915–16, and was the coldest winter since 1894–95, when the mean was 35·1°, and the lowest in the last seventy-five years was 34·3° in 1890–91. Frost occurred in the shade on fifty-two nights during the three months, the occurrences being respectively 18, 19, and 15. Frost also occurred during the latter half of November, and it is occurring occasionally during the present month. The aggregate rainfall was less than the normal; the total measurement was 4·49 in., which is 86 per cent. of the average fall for the last sixty years. December was the only month with an excess of rain, and in all there were forty-eight days with rain. The duration of bright sunshine was 63 per cent. of the average, and there were forty-eight sunless days in the three months, comprising in all ninety days.

THE Transactions of the Optical Society of London for the session 1915–16 extends to more than 300 pages, twelve of which are occupied by subject and name indexes to the sixteen volumes of Transactions which have now appeared. One of the most valuable papers in the volume is that of Dr. Boswell on the properties which sand must possess to be suitable for glass making, and especially for optical glass making. By an examination of the optical glass sands of Fontainebleau and of Lippe he finds that the ideal sand for the purpose should consist of 100 per cent. silica, be practically free from iron, organic and clayey matter, and be in angular grains of the same size,

unless the melting-pots are arranged for stirring. There are no sand beds at present known in this country from which sand for optical glass making can be obtained of such uniformity and at so low a cost as that from Fontainebleau. There are, however, large supplies of sand suitable for good flint glass, laboratory glass, table ware, plate glass, etc. Dr. Boswell points out that the whitest and best sand is almost invariably found associated with carbonaceous matter and often in the coal measures.

A USEFUL contribution to our knowledge of alternating stress is contained in a paper read at the Institution of Mechanical Engineers on February 16 by Dr. William Mason, of Liverpool University. The machine used in the experiments was designed by the author so as to be capable of applying repeated torsion, or bending, or repeated torsion and bending simultaneously. It is a slow-speed machine, and most of the work was carried out at frequencies either less than, or very little exceeding, 200 cycles per minute. This plan has several advantages to recommend it. Typical curves were obtained showing how the cyclical range of strain varies with the range of stress and with the number of cycles endured. The material used was a dead mild steel. The range of stress under which the elasticity became impaired was always fairly definite. It was also found that a large number of repetitions were endured at ranges of stress that induced considerable ranges of extra-elastic strain. It is probable that the range of stress that would cause fracture in, say, 100 million cycles will be nearer in amount to the range that actually produced fracture in 1 to 5 million cycles than to the range of stress that brought departure from the elastic condition. The calculated ranges of stress at which cracking occurred were found to be greater for solid than for hollow test-pieces. The effect of giving rest to a specimen in which an extra-elastic range of strain has developed is to reduce the range of the strain; the effect appears to be similar to that of hardening after strain, and not to be of the nature of recovery of elasticity. No real adjustment of elastic limits (with equal + and − stresses) was observed. There appears to be a marked variation, with frequency of repetition of cycle, of the physical state of mild steel subjected to repetition of a higher range of stress than that consistent with unimpaired elasticity, the mobility being greater with higher frequency. For the quality of mild steel used, the range of induced maximum shear stress, at which the elasticity becomes impaired, is sensibly the same in both alternating torsion and alternating bending, thus showing agreement with Guest's criterion of elastic failure.

MESSRS. JOHN WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued a catalogue (New Series, No. 78) of second-hand books dealing with chemistry which should be of service to many readers of NATURE. It comprises the library of the late Dr. Hugo Muller, and is particularly rich in German works. Complete sets of the *Chemical Gazette*, the *Chemist*, *Chemical News* (to 1916), Journal, Proceedings, and Annual Reports of the Chemical Society of London (to 1916), the *Technologist*, and the Journal of the Royal Society of Arts (to 1913) are offered for sale.

THE following volumes are in preparation for appearance in the "Cambridge Psychological Library" (*Cambridge University Press*):—Psychology, Prof. J. Ward; The Nervous System, Prof. C. S. Sherrington; The Structure of the Nervous System and the Sense Organs, Prof. G. Elliot Smith; Prolegomena to Psychology, Prof. G. Dawes Hicks; Psychology in Relation to Theory of Knowledge, Prof. G. F. Stout; Mental Measurement, Dr. W. Brown; The Psychology of Mental Differences, C. Burt; Collective Psychology, W. McDougall; The Psychology of Personality and Suggestion, Dr. T. W. Mitchell; and The Psychology of Dreams, T. H. Pear.

OUR ASTRONOMICAL COLUMN.

COMETS 1915*a* AND 1916*b*.—The following continued ephemeris of comet 1915*a* (Mellish), calculated for Greenwich mean midnight by Mlle. J. Vinter-Hansen, has been circulated by Prof. Strömgren:—

1917	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ
Mar. 22	4 59 26	+41 25.0	0.8502	0.8597
26	5 0 43	22.1		
30	2 10	19.5	0.8543	0.8710
Apr. 3	3 44	17.5		
7	5 5 26	+41 15.9	0.8584	0.8816

During the above period the path of the comet is in Auriga.

Prof. Strömgren also reports an observation of comet 1916*b* (Wolf), made at Copenhagen with the 14-in. equatorial on March 1. The comet is described as being very faint, and the corrections to the ephemeris were −56s. +3′.

The following continued ephemeris is given by Dr. Crommelin in the February number of the *Observatory*:—

1917	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ	Brightness
Mar. 22	18 56 26	+2 8	0.3063	0.2989	28
26	19 5 59	3 2			
30	15 36	3 59	0.2946	0.2751	33
Apr. 3	25 16	4 58			
7	35 1	6 0	0.2833	0.2517	39
11	44 50	7 3			
15	19 54 43	8 9	0.2725	0.2291	45
19	20 4 40	9 16			
23	14 41	10 24	0.2622	0.2074	53
27	20 24 46	+11 34			

The brightness on April 3, 1916, is taken as unity, and no allowance is made for physical causes of brightening. It is expected that the comet will become bright enough to be visible to the naked eye during June and July.

THE SUN-SPOT ZONES.—The results of an examination of the latitudes of sun-spots, as recorded in the Greenwich observations for the period 1879 to 1911, have been given by H. Arctowski (*Mem. Soc. Spett. Ital.*, February, 1917). As in the previous discussions by Mr. Maunder and Dr. Lockyer, he finds that the curve showing the variation of latitude during an 11-year cycle does not fall continuously from high to low latitude, but has several subsidiary maxima and minima. The phase of the cycle is shown to be different in different zones. Thus, in the period 1889–1903, the maximum frequency of spots in the zones 20° to 30° occurred in 1892; in the zones 20° to 10° it occurred in 1893; and in the zone +10° to −10° in 1894. Spots ceased to be visible in the first of these zones in 1896, in the second they remained until 1901, while in the third they did not appear until 1891 and persisted to 1903, two years after the new cycle had begun. The curves suggest that there is a superposition of a number of distinct variations, of which the principal corresponds to the simplified Spörer's curve and extends throughout the cycle, while some persist only a few years, and others may be of very short duration. The variation would thus appear to proceed by a succession of impulses.

A GROUP OF FOSSIL PLANTS.[1]

THE publication of Mr. Wieland's first volume in 1906 was an event of great importance which had a wide influence on botanical research. The author gave an account of the floral and vegetative morphology of several species of Cycadeoidea, a genus represented in Upper Jurassic and Lower Cretaceous strata in many parts of the world, but nowhere on so large a scale as in the United States, where hundreds of well-preserved trunks have been found. Though agreeing generally in habit and in most anatomical features with recent Cycads, Cycadeoidea is characterised by reproductive shoots of a type far removed from that of the existing members of the Cycadaceæ. The work accomplished by European investigators since Wieland's first volume was published is summarised in the present volume, which also contains many new facts and amplifies the earlier descriptions; it also includes some account of the author's Mexican expedition in 1909–10, which yielded a rich harvest of Liassic Cycadean fossils. Incidentally Mr. Wieland emphasises the importance of personal observation in the field, and gives salutary advice to many of us who have neglected this part of a palæobotanist's duties. He directs attention to the short-sighted policy of some museum authorities in refusing to allow their specimens to be disfigured by the lapidary's wheel.

The American Cycads are divided into groups in part geographical and in part morphological, and each set of forms is critically discussed from a taxonomic point of view. The Maryland stems agree closely with the English specimens described by Buckland from Portland, and British students are reminded that they have not fully investigated their own material. Two of the most interesting species described and beautifully illustrated are *Cycadeoidea colosallis* and *C. Dartoni*, the latter founded on a portion of a trunk bearing 500 to 600 strobili, most of which contain well-preserved seeds and embryos. A chapter on the seeds of Cycadeoidea is especially interesting; in it the author develops more fully his views on the evolutionary history of seeds as represented more particularly by those of the Bennettitales. The structure of the American seeds agrees in essentials with that of European types, the most complete account of which we owe to the late Prof. Lignier. Wieland institutes comparisons between the Mesozoic Cycadean seeds and several Palæozoic genera, such as Lagenostoma, Conostoma, and others, and in the course of the discussion he gives a summary of recent work on the older seeds. He suggests that the genus Codonotheca, usually regarded as the male flower of some Pteridosperm, may be a bisporangiate shoot, which originally contained a central seed, though there is no definite evidence of this, surrounded by a whorl of microsporophylls. His contention is that the complex seed-coats of Palæozoic and later types are the result of sterilisation and fusion of encircling leaves or sporophylls round a central spore; in other words, he interprets the elaborate seed-coats as reduced foliage-organs which have become intimately associated with a megaspore. It is, however, noteworthy that the bisporangiate flowers of such a type as *Cycadeoidea colosallis* are apparently more primitive than the much older Palæozoic seeds, which show no trace of any encircling whorl of leafy organs.

In a chapter on Cycad derivatives Wieland ranges over a wide field, but without committing himself definitely to any clearly defined view on the question of a relationship between the Angiosperms and the Cycadean stock. He holds that the columnar, and often unbranched, stems characteristic of the great majority of the Cycadeoideas are an unusual type derived from a much more slender and freely branched ancestral form. Comparisons are made between the Magnoliaceæ and the Bennettitales, and reference is made to opinions on the evolution of the Conifers, the position of the Gnetales, and other questions. His survey of the fossil Cycads leads to the conclusion that the true Cycads were probably never more abundantly represented than they are to-day: they were preceded by the Cycadeoidea type, a comparatively stereotyped form, and at an earlier stage the Williamsonia group occupied the dominant position, a group exhibiting a much greater range in the form of flower and stem. Some account is given of Cycadean foliage from Mesozoic strata, and of the rise and decline of the Cycad element in Mesozoic floras from the Rhætic to the early Cretaceous period, when the Angiosperms assumed the leading *rôle*.

Mr. Wieland's second volume is a contribution of considerable importance by an author who has well earned the right to speak with authority on a subject of exceptional interest; but after reading the long theoretical discussions, which are suggestive, though the conclusions are often open to question, one regrets that more attention was not paid to the elucidation of several morphological problems that are still unsolved, and on which the splendid American material can undoubtedly throw much light. The author is an enthusiast with a vivid imagination, and does not always fully appreciate the difficulties of the problems before him; his desire to solve the mysteries of the early stages in plant-evolution leads him into deep waters of speculation, and his points are not always easy to grasp owing to a diffuse style and the lack of concise summaries of conclusions. The photographic plates are probably the most striking illustrations of fossil plants ever published, and the student owes a debt of gratitude, not only to the author, but also to the officials of the Carnegie Institution.

A. C. SEWARD.

[1] "American Fossil Cycads." Vol. ii., "Taxonomy." By G. R. Wieland. Pp. 1–267+plates i–lviii. (Published by the Carnegie Institution of Washington, 1916.)

METEOROLOGY AND THE SOLAR CONSTANT.

THE Journal of the Scottish Meteorological Society (No. xxxiii.), recently issued, contains, as usual, some very interesting articles.

Lieut. Douglas, Royal Flying Corps, gives some details of his experience during his ascents amongst the clouds in northern France. He finds stratus cloud most frequently in anticyclones and round their eastern and northern borders. The top in such cases is very flat and even, and an inversion of temperature is met with at the upper surface. The lowest temperature is generally at the top of the cloud, but is occasionally met with a little lower. If cumuli attain sufficient height they develop into thunderstorms, but at least 6000 ft. from top to bottom is required for this to happen, and on all occasions in 1916 when thunder developed, the height was not less than 10,000 ft. Mr. Douglas states that cirrus and cirro-stratus almost certainly consist of thin snow.

Dr. Knott discusses the value of the solar constant and the associated problems, giving chiefly a summary of the work of Abbott and Fowle and Anders Ångström. He explains very lucidly the method devised by Langley, by which the error caused in determining the constant by the selective absorption and radiation of the air is overcome. The values obtained for the constant range from 1·97 at Washington to 1·92 at Mount Whitney (14,500 ft.), the mean of 573 observations at Mount Wilson (5670 ft.) gives 1·93, and Dr. Knott considers that we may take these results as correct, so that the solar constant is very nearly 2 gram-calories per cm.^{2} per minute. This is

equivalent to an average of 0·5 g.-c. per cm.[2] per minute received at the outer surface of the atmosphere over the whole earth.

Out of the radiation received Abbott and Fowle consider that 37 per cent. is reflected, chiefly by the air and clouds, and to a small extent by the earth. The figures they give are that out of the whole radiation reaching the outer limit of the atmosphere 52 per cent. reaches the level of Mount Wilson and 24 per cent. the surface of the earth.

The experiments of Ångström were on what he calls the effective radiation of the earth—that is to say, the whole radiation from the surface less the back radiation from the air. The returned radiation from the air depends on the amount of water vapour present, and since this increases with increasing temperature, the effective radiation is found to increase slightly with decreasing temperature. Ångström also states that dry air will radiate with half the radiation of a black body.

The other articles are on the underground drainage of the upper part of the Dee Basin, by Dr. John Horn, and on the distribution of cloud and rain with reference to the centre of a cyclonic depression, by Sir Napier Shaw. The latter contains four very interesting illustrations showing the average distribution in four well-defined storms that passed over the British Isles at various dates The areas of rain and also of cloud lie on the whole in front of the centre, but have not any very definite shape. The author remarks that "even in well-marked depressions convection is a local phenomenon."

The usual meteorological tables for Scotland for 1915 complete the volume.

SCIENCE AND MODERN LANGUAGES IN CIVIL SERVICE EXAMINATIONS.

It is a matter of common knowledge that the country is largely governed by men who enter the Civil Service as first-class clerks, since from these men the principal permanent officials are so frequently chosen. Attention has been directed to the fact that nearly all these positions are filled by persons whose main educational qualifications are a considerable knowledge of Latin and Greek.

In reply to this, the defenders of the system pointed out that in 1913 the first and third places in the examination were taken by students of science, and that in 1914 the second place was gained by a science man.

But these figures are most deceptive, as the following statistics will show. In 1913 sixteen vacancies were announced. Of the first sixteen candidates, twelve took Latin and Greek, and all of these Greek history and Roman history; only four took mathematics and science; only two took French—one evidently as a make-weight, since he did not get enough marks to enable him to count the subject; none took Italian or German. Of the two who took French, one secured 254 marks out of a total of 2320, and another no marks out of a total of 2344.

The men who gained the first sixteen places secured marks as follows:—

Greek	6,250
Latin	5,817
Greek history	3,580
Roman history	3,673
	19,320

Greek history and Roman history are counted in with Greek and Latin because, as can be seen by the papers, nearly all the questions can be answered by anyone who has made a careful study of Greek and Latin literature in which the history of the two nations is embedded.

The same sixteen candidates secured the following total marks for the subjects mentioned:—

Mathematics	6,707
Natural science	3,491
French	254
Italian	0
German	0
	10,452

In other words, mathematics and science and modern languages secured much less between them than classics.

In 1914 nine vacancies were announced; of the candidates who took the first nine places, seven took both Greek and Latin, and of those, six took both Greek and Roman history; only two took mathematics with some science, and only two took French; none took Italian or German. The two who took French scored for this language 417 marks out of a total of 3876 and 321 out of a total of 3094 respectively. The two who took science scored respectively 859 marks out of a total of 3528 and 561 out of a total of 3408.

The men who gained the first nine places secured marks as follows:—

Greek	3,453
Latin	4,528
Greek history	1,745
Roman history	1,834
	11,560

The same nine candidates secured the following total marks for the subjects mentioned:—

Mathematics	3,901
Natural science	1,401
French	738
Italian	0
German	0
	6,040

It will be seen that the candidate who studies anything but Latin or Greek has a comparatively small chance of success in the examination; the result is that the country is largely governed by persons who, for the most part, have little knowledge of, or sympathy with, scientific method, and who are frequently unwilling to accept scientific advice; many of the appalling mistakes made at the beginning of the war were due to this.

Another result of the present system of examination, which allots an altogether disproportionate number of marks to Latin and Greek as compared with science and modern languages, is that the higher posts in the Civil Service are practically closed to persons who have not been educated at either Oxford or Cambridge. In 1913 and 1914 forty first-class clerks were selected; of these, twenty-five came from Oxford; ten from Cambridge; one from the University of London; one from a Scotch university; two from Irish universities; *and none from all the provincial universities in England and Wales combined!*

Everyone would regret if the higher posts in the Civil Service were not recruited largely from Oxford and Cambridge; but it is ridiculous to suppose that all the provincial universities combined were incapable of producing, during the last two years before the war, a single person worthy thus to serve the State. Men from the modern universities have little chance of success, since the endowments for higher classical teaching are largely concentrated on the banks of the Isis and the Cam.

J. Wertheimer.

THE VALUE OF RESEARCH IN SCIENCE.[1]

SCIENCE of some sort is now being very widely taught at all stages of education, and so far from its progress being impeded as used to be the case by disadvantages of a public kind, most Governments are more or less alive to the importance of devoting public funds in furtherance of scientific work, and almost every honours list now contains the names of men distinguished in science. In India the various Governments have made a very fair beginning in the matter of funds.

It is impossible, and would be of little value for our purposes, to estimate the amount devoted to scientific teaching in schools and colleges by the various education departments. I have, however, endeavoured, with the kind assistance of the Hon. Mr. Davidson and the Financial Department of the Government of Madras, to form some idea of the amount being spent upon original research and other higher scientific work throughout India.

On the nature and essence of "research" I propose to offer a few observations later on, but it is not without interest to note at this point the connections in which the word occurs in the various Budget estimates. The Government of India supports a Forest Research Institute and College at Dehra Dun, and devotes about 4 lakhs a year to it; it contributes 5 lakhs a year to the Indian Research Fund, about 5½ lakhs to the Agricultural Research Institute at Pusa, and a lakh to the Central Research Institute at Kasauli.

Some of the local Governments have entertained, or propose to entertain, what they call in the Budget forest research officers. The Agricultural College in the Madras Presidency has for part of its title that of Research Institute. The Government of Bengal gives research scholarships. The Punjab Government enters a small portion of its contribution to Government colleges as research grant. In Burma a small sum is devoted to what are called leprosy researches.

The Budgets, however, provide for many other forms of scientific activity in connection with which the word "research" does not happen to have been used, such as: further experimental work in connection with agriculture, bacteriological work as affecting man and animals, other investigations of a medical nature, and work relating to fisheries and other industries.

Further, various Governments support museums, in some of which, at any rate, scientific work is carried on, and our institute here at Bangalore receives an annual grant of Rs.87,500 from the Government of India, which has promised, should any private individual be willing to subscribe, to provide a like amount so long as its total grant does not exceed Rs. 1,50,000.

There are also the various Imperial surveys; in some of these the expenditure must, of course, be mainly debited to administrative work, but in the majority of them the funds do something towards the progress of science.

Without taking the surveys into account, the annual expenditure from public funds on scientific work in British India is somewhere in the neighbourhood of Rs.70–80 lakhs—that is to say, 500,000*l.*—and to this must, of course, be added large capital sums invested in buildings. This expenditure is supplemented to some extent by the more progressive of the native States, including, I need scarcely say, the State in which we have the pleasure to be at present. Lastly, private sources have contributed, but to a lamentably small extent. In this last respect there have been a few striking exceptions, and perhaps the foremost of these was the projected gift of the late Mr. Tata, to the carrying out of which by his sons our institute owes its existence.

Now I propose to deal with the question of research. Research is often alluded to as a perfectly simple operation; one even hears of men being "taught to research"; newspapers speak of it in the lightest manner, whereas in even my student days it was spoken of with almost bated breath as indicating something to which only the best of us could look forward, something which few of us were ever likely to carry on with any hope of success.

It is probably impossible to find a classification of research work devoid of considerable overlapping, and in many cases the motives are undoubtedly mixed, but it seems possible to recognise three classes: that carried on with the single purpose of ascertaining the truth in regard to the causes of things; that which has for its immediate object a specific utilitarian purpose, but still without any expectation whatever of a pecuniarily remunerative result; and research with the avowed object of making money out of it sooner or later.

The first and second classes would come under the head of scientific research in the sense in which the term is used by the Privy Council Department of Scientific and Industrial Research, while the third class is industrial research; but what I want to emphasise is the fact that the first class alone is research in pure science, while the second and third classes are both research in applied science—that is, science put to practical use; practical as distinguished from abstract or theoretical.

Huxley said that what people call applied science is nothing but the application of pure science to particular problems. The Advisory Council says that this no doubt is so; there are not two different kinds of science; at the same time it realises that it has to deal with the practical business world, in the eyes of which a real distinction seems to exist between pure and applied science. There are, however, men in the business world who see more clearly. An American manufacturer pointed out only the other day that "there are no sharp lines to separate pure from applied, scientific from practical, useful from useless. If one attempts to divide past research in such a manner he finds that time entirely rubs out the lines of demarcation."

But whatever terms have been used, the application of scientific knowledge for the good of mankind is as old as that knowledge itself, and one may safely say that the majority of those who have attempted this application have not been swayed by any pecuniary motive. The scientific agriculturist is not in most cases the person into whose pockets comes the money secured by the use of better methods. Medical science in all its branches is applied science, and although the doctor may earn his living by means of fees, medical research is not undertaken from pecuniary motives. It has been for the most part the application to a particular problem of the scientific knowledge of the day, and there has, of course, been no such application with a more noble purpose. Still, it is not pure science, and there have often been medical men who have left further application to others, while they have reverted to purely scientific problems.

What utilitarian research would have discovered the fundamental facts in regard to electricity or have led to the framing of the atomic theory? Who can say how many profound truths await discovery because some utilitarian who happened upon a glimmering of them did not think it worth while to pause and investigate the apparently irrelevant?

[1] From the presidential address delivered before the Indian Science Congress, Bangalore, January, 1917, by Sir Alfred Gibbs Bourne, F.R.S., K.C.I.E.

How much research has been undertaken by the student of pure science which he would have frankly admitted to be apparently useless? How much patient work and loving care have been bestowed upon investigations seemingly impossible of application to any of the specific problems of the day? Upon research of this kind no utilitarian would have been at all likely to embark, yet sooner or later such research has either proved capable of direct application or—and this has more often been the case—has unexpectedly formed a corner-stone, or occupied a more humble but still useful position, in building up some far-reaching generalisation capable of being seized upon at once by the worker in applied science, thus in turn perhaps stimulating further scientific research.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject proposed for the Adams prize essay for the period 1917–18 is "The Diffraction of Sound Waves." The solution of a typical problem or problems, such as that of diffraction by a circular or rectilinear aperture in a plane screen or by a circular disc, is desired free from approximations or restriction to relatively long waves. Treatment of the corresponding problems in electric waves is also suggested.

The question of compulsory Greek in the Previous examination has been very prominent during the present term. The case for the abolition of compulsory Greek has advanced greatly since 1905, when it was put to the vote and defeated. A syndicate appointed in 1913 to consider the regulations for the Previous examination reported that it was unable to recommend that Greek should continue to be a compulsory subject, and a new scheme was drawn up for the examination in which Greek was made alternative to French or German. Had it not been for the outbreak of war, this reform would probably by this time have become an accomplished fact, but, as it was, the discussion of the report was delayed until last year, and afterwards the syndicate expressed the opinion that it was inexpedient to bring the scheme before the Senate while so many members of the Senate were absent on war service

Early in the present term the council of the Senate issued a report on the subject. The council agreed that it was inadvisable to proceed at once with the whole question of the reform of the Previous examination, since this should be considered together with the considerable modification and reconstruction of the educational system of the University which was likely to take place after the war; but it held that the question of Greek was of practical urgency at the present time, and it was of opinion that, as a temporary provision, the papers at present set in French and German (which are easier than those proposed by the syndicate) should be alternative to Greek. However, the council had ascertained that if a discussion were held and a vote taken in the existing circumstances, it would be greatly resented by some members of the Senate absent on war service, and it had accordingly decided not to take action at the present time. This aroused widespread disappointment in the University, and a memorial bearing a long and influential list of signatures was presented to the council asking it to reconsider its decision. A counter-memorial was presented; strong protests were also issued by a small number of residents now engaged on war service in various Government offices. The result has been that the council adheres to its decision to take no action at present, but the constitution of the Previous examination is to be considered further, so that it may be possible to take action immediately upon the conclusion of the war.

THE third conference of the Committee for the Development of Regional Survey will be held at Newbury on April 7–17, and it is proposed to make a detailed study of the town and region. No formal classes will be held or lectures given, but there will be daily conferences for the purposes of study. The committee hopes that sufficient workers will be able to attend the conference to make all aspects of the regional survey possible, physical, historical, and social. Members are asked to communicate with the hon. local secretary, Kingsbridge Road, Newbury.

THE governors of the Imperial College of Science and Technology have recently considered the conditions to be fulfilled in the case of students of the Royal School of Mines whose associateship courses of study have been interrupted by their undertaking service with the Forces of the Crown or other approved war-work, precedent to the award to them of the diploma of associateship of the Royal School of Mines in Mining or in Metallurgy or in Oil Technology. Instead of insisting upon the full four-year course, the opportunity is offered for a student to complete in three years the tests ordinarily imposed, having regard to experience gained during the war, and, in that case, the reduction is contemplated of the requirement as regards practical work (shifts) by one-third, and the possibility of a man making good in certain arrears of subjects during vacations, but it is considered inadvisable to make any curtailment of the work of the first and second years.

AT a representative and largely attended conference of examining bodies in Great Britain held on March 15 at the Board of Education under the presidency of Mr. A. T. Davies, chairman of the British Prisoners of War Book Scheme (Educational), it was unanimously decided, on the motion of Sir Edward Busk (University of London), to approve certain proposals for the encouragement and recognition of the studies pursued by prisoners during their internment. Steps are being taken to give effect to these proposals, and various examining bodies (including most of the universities) have already intimated their willingness to recognise work done and examinations passed in the camps, and to extend to the men on their return facilities for sitting for examinations under conditions which will take account both of their special circumstances and their needs. A message was read from the President of the Board of Education in which Mr. Fisher expressed sympathy with the objects of the conference and his belief that the result of its efforts would prove a great encouragement to the men to use wisely and well the time of their captivity, and, further, would be of material assistance to them on their return to this country. It is intended that the decision arrived at shall be communicated, as soon as possible, as "a message of encouragement and hope" to the various internment camps in enemy and neutral countries. In the meantime it was suggested that friends and relatives of student prisoners might do them a service if, when writing to them, they will direct their attention to the steps in this connection which are being taken on their behalf.

THE issue of the Journal of the Royal Society of Arts for March 9 contains a paper on "German Methods" by Mr. J. H. Vickery, read before the society on March 7. In it Mr. Vickery deals, among other matters, with German education and science. He points out that it is the habit of the Germans to refer to the English as being a "practical" people. But he urges that, in point of fact, the German has

been much more practical in the matter of turning scientific knowledge to account. "With all his boasted idealism he has long since ceased to follow scientific research purely and solely for the love of the thing." He "has been taught that if science possesses any practical value it would be an unpardonable violation of an economic law to allow that value to go unexploited. As a result the university and Government laboratories are closely linked up with the factories and workshops of the nation." Scientific achievement both in theory and in practice receives higher recognition in Germany than in any other country. That commercial and industrial use is made of the achievements of science has not lowered the tone of the German man of science, but has raised the tone of German industries. In Germany, says Mr. Vickery, "not merely one man as a voice crying in the wilderness, but a thousand voices, from the Kaiser downwards, have been crying in chorus—*Think scientifically, act scientifically.*" There is no need, he thinks, for us to copy German methods, for if we once recognise the underlying truths of scientific development, both in theory and in practice, we shall be able to work out the methods of fruitfully applying the discoveries of science.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 8.—Sir J. J. Thomson, president, in the chair.—W. B. **Bottomley**: Some effects of growth-promoting substances (auximones) on the growth of *Lemna minor* in culture solutions. 1. Raw peat, when further decomposed by means of aerobic soil organisms—"bacterised peat"—is found to contain certain growth-promoting substances (auximones). 2. *Lemna minor* plants cannot maintain growth for any length of time in culture solutions containing only mineral nutrients. 3. The presence of soluble organic matter is essential for complete growth. 4. The addition to the mineral culture solution of 368 parts per million of organic matter from the water extract of bacterised peat resulted, after six weeks, in a multiplication of the number to 20 times, and an increase in weight to 62 times, that of the control plants. The water extract free from humic acid, representing an addition of 97 parts of organic matter per million, gave $9\frac{1}{2}$ times the number and 29 times the weight; 32 parts per million from the alcoholic extract gave $3\frac{1}{3}$ times the number and $7\frac{1}{3}$ times the weight; 13 parts per million from the phosphotungstic fraction gave $1\frac{1}{2}$ times the number and $2\frac{1}{2}$ times the weight. 5. The effect of the reduction in amount of auximones with successive fractionation of the bacterised peat was also manifest from the general appearance of the plants. Those in mineral nutrients only, decreased in size week by week, and became very unhealthy in appearance, whilst there was a progressive improvement in the appearance of the plants supplied with increasing amounts of auximones. Those receiving the larger amounts retained their normal healthy appearance throughout the experiment and increased in size. 6. The beneficial effect of the auximones was not due to a neutralisation of the toxic substances present in the ordinary distilled water, since comparable results were obtained with conductivity water. 7. An interchange of culture solutions, with and without auximones, showed that the plants are very sensitive to the presence or absence of these substances.—Florence A. **Mockeridge**: Some effects of growth-promoting substances (auximones) on the soil organisms concerned in the nitrogen cycle. This investigation deals with the effect of bacterised peat and the various auximone-fractions obtained from it upon the four chief groups of soil bacteria concerned in the nitrogen cycle, *in situ*, and in liquid culture. The addition of bacterised peat to soil increased the rate of nitrogen fixation quite independently of any bacteria contained in the material. This increase was not due to aeration, nor could it be brought about by chemically treated peat. Experiments in liquid culture showed that a water extract of this material greatly increased the nitrogen fixation of Azotobacter and of *Bacillus radicicola*. An alcoholic extract and the decomposed phosphotungstic acid and silver baryta fractions from it were also very effective. Similar results could not be obtained with chemically prepared soluble humus or with artificial humus. The accumulation of nitrate in soil containing bacterised peat was greater than that which could be accounted for by the soluble nitrogen which it contained, and took place more rapidly than in a similar soil provided with an equal amount of soluble nitrogen as ammonium sulphate. Since the water extract of the material was found to be directly nitrifiable, its effect upon the rate of nitrification was not tested, but the auximone-fractions, which were not nitrifiable, greatly increased the rate of nitrification of ammonium sulphate solutions. The auximone-fractions were without effect upon the rate of ammonification in soils and upon the ammoniacal fermentation of urea. The water extract had no effect upon the rate of denitrification, but the auximone-fractions directly inhibited the process. The work indicates that certain decomposition products of organic matter stimulate the activities of certain soil bacteria, and appear to play an important part in nitrogen metabolism.

Physical Society, February 9.—Prof. C. V. Boys, president, in the chair.—Dr. A. **Griffiths**: Note on the calculation of the coefficient of diffusion of a salt at a definite concentration. In the calculation of the coefficient of diffusion, by B. W. Clack, a simple relation is assumed between the density of a solution of a salt and the concentration. This simple relation is only approximately correct, and compromises are made which require justification. This note (1) suggests a method of calculating the coefficient of diffusion which, to a high degree of theoretical accuracy, gives values for the coefficient which are independent of a precise relationship between density and concentration; and (2) justifies the method of calculation adopted by B. W. Clack.—Dr. P. E. **Shaw** and C. **Hayes**: A special test on the gravitation temperature effect. In the Philosophical Transactions of the Royal Society, vol. ccxvi., pp. 349–92, there is a paper by one of the authors dealing with the possible existence of a temperature coefficient of the constant of gravitation. It was suggested in the discussion that the effect might be due to an inward displacement of the large lead spheres, at the higher temperatures, due to convection currents. In the present paper experiments are described in which this point is tested by micrometric measurements of the positions of the supporting wires. It is shown that, at the higher temperatures, there is a small *outward* displacement of the spheres, probably due to the expansion of the crosshead from which they are suspended. A slightly *higher* value has, therefore, to be given to the temperature coefficient of gravitation.

Geological Society, February 16.—Annual general meeting.—Dr. Alfred Harker, president, in the chair.—Dr. A. **Harker**: Anniversary address. Some aspects of igneous action in Britain, especially its relation to crustal stress and displacement. This relation appears not only in the distribution of igneous activity in time and space, in the succession of episodes, the habits of intrusions, etc., but also in the petrographi-

cal facies of the igneous rocks themselves. The cause of such relation was sought in the existence of extensive inter-crustal regions in a partially molten state: that is, with some interstitial fluid magma, which must normally be rich in alkaline silicates. There will be a continual displacement of the interstitial magma from places of greater stress to places of less stress, and certain broad differences in chemical composition are therefore to be expected between the igneous rocks of orogenic belts and those erupted in connection with gentle subsidence.

February 28.—Dr. Alfred Harker, president, in the chair.—Dr. A. **Smith Woodward**: Fourth note on the Piltdown gravel, with evidence of a second skull of *Eoanthropus dawsoni*. With an appendix on the form of the frontal pole of an endocranial cast of *Eoanthropus dawsoni* by Prof. G. **Elliot Smith**.—Excavations last summer round the margin of the gravel-pit at Piltdown (Sussex) supported the conclusion that the deposit is a varied shingle-bank, and that the three layers containing Palæolithic remains and derived Pliocene fossils are approximately of the same age. Many elongated flints and pieces of Wealden sandstone were observed in the bottom sandy clay with their long axis more or less nearly vertical. No teeth or bones were found, but one nodular flint obtained from the same layer as Eoanthropus seems to have been used by man as a hammer-stone. This is not purposely shaped, but merely battered along faces that happened to be useful when the stone was conveniently held in the hand. In the winter of 1915 the late Mr. Charles Dawson discovered in a ploughed field, about a mile distant from the original spot, the inner supraorbital part of a frontal bone, the middle of an occipital bone, and a left lower first molar tooth, all evidently human. These are rolled fragments, and the first and third may be referred with certainty to *Eoanthropus dawsoni*; but it is doubtful whether they represent more than one individual. In mineralised condition they agree with the remains of the type-specimen. The piece of frontal bone exhibits the characteristic texture and thickness, with only a very slight supraciliary ridge, and a small development of air-sinuses. The occipital bone is somewhat less thickened than that of the original specimen of Eoanthropus, and bears the impression of a less unsymmetrical brain. In an appendix Prof. G. Elliot Smith expresses the opinion that the endocranial cast of the fragment of frontal bone presents features more primitive and more ape-like than those of any other known member of the human family.

Zoological Society, February 20.—Dr. A. Smith Woodward, vice-president, in the chair.—C. J. C. **Pool**: Insects reared in the insect house during 1916. Experiments showed that melanic variations of the magpie moth (*Abraxas grossulariata*) were not connected with melanic variations in the larva. In the case of dragonflies, although the larvæ of several British species had been reared to maturity, it was found impossible under the conditions to feed the full-grown insects, which survived only a few days after emergence from the water. Similarly, it was found impossible to feed various species of Longicorn Coleoptera, although other beetles, differing as widely in diet as Carabidæ and Lamellicorns, fed readily on banana. Experimental feeding with beetles of the genus Necrophorus showed that while these insects were refused by meerkats (Suricata) they were eaten by a mongoose and Capuchin monkeys.—A. de C. **Sowerby**: Heude's types of artiodactyle ungulates in the Sikawei Museum, China. In the case of the species of Sus, Cervus, Capricornis, and Nemorhædus it was shown that Heude had disregarded variations due to age, season, and other causes, and that in each of these genera the number of species must be greatly reduced.—G. A. **Boulenger**: The lizards of the genus Philochortus, Matschie.

March 6.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. F. E. **Beddard**: The scolex in the Cestode genus Duthiersia, and the species of that genus.—Capt. S. R. **Douglas**: Results of an experimental investigation of the migration of woodcock breeding in the West of Ireland. The paper, among other interesting points, showed an increase in the number of woodcock breeding in the West of Ireland.

Linnean Society, March 1.—Sir David Prain, president, in the chair.—J. C. **Mottram**: Observations upon the feeding-habits of fish, more especially of *Salmo fario*, and of riverside birds. These observations, extending over a period of eight years and supplemented by from between 500 and 600 autopsies, show that the liability to attack of any species depends upon many factors, such as the general and special hunger of the preyer, the total and relative abundance of the food-supply, the abundance and ease of capture of the preyed upon, and its relative palatability. It follows that in order to estimate the palatability value of a species, it is necessary to take into account all these factors. The observations indicate that species cannot be sharply divided into palatable and unpalatable. Observations are also recorded which show that both fish and birds are deluded by rough resemblances to insects on which they may be feeding, and that therefore a rough mimicry may be of some value in the struggle to exist.—Dr. J. C. **McWalter**: A note on botany in Malta. The note began with remarks on the prevalence of *Oxalis cernua*, Thunb., in Malta, still as universal as it was more than twenty-five years ago, when Prof. George Henslow wrote about it (Proc. Linn. Soc., 1890–92, pp. 31–36), which is still quoted as the most recent contribution to its study. Seasons at Malta are numerous, uncertain, and erratic, but the Cape sorrel seems most prevalent in March and April; it is now called "The English Weed." Dr. McWalter next suggested the cultivation of certain medicinal plants, of which the present supply is short, but well adapted in his view for growth in Malta. "Labour is, as a rule, cheap, and though an era of prosperity now prevails on account of the war, it is thought that great distress will prevail afterwards unless useful work be provided for the people."

CAMBRIDGE.

Philosophical Society, February 5.—Dr. Marr, president, in the chair.—Dr. **Marr**: Submergence and Glacial climates during the accumulation of the Cambridgeshire Pleistocene deposits. Near Narborough, at March and elsewhere in the fens marine deposits occurred from below fen-level to a height of at least fifty feet above present sea-level, indicating a submergence followed by re-emergence. Evidence was given to show that the later Pleistocene deposits of the neighbourhood of Cambridge indicated the same two movements, and that the encroachment of the sea took place in Lower Palæolithic times, and the recession in Upper Palæolithic times. The climate in Lower Palæolithic times was apparently warm, and there is some evidence of a cold period at the end of these times. Warmer conditions probably followed, and towards the end of Upper Palæolithic times a second period of cold is marked by the presence of the reindeer and an arctic flora in the pit near Barnwell Station. Prior to the Lower Palæolithic times the chalky Boulder Clay was accumulated; we therefore seem to have evidence of three cold Pleistocene

periods. This accords with the views of Continental geologists.—P. **Lake**: Glacial phenomena near Bangor, North Wales. During the Glacial period the valley of the Ffryddlas was blocked at its mouth by the Ogwen glacier and converted into a lake. The valley shows three terraces, and three corresponding overflow channels are cut in the ridge which bounds the valley on the north. One of these overflow channels debouches high up on the seaward slope of this ridge, and it is concluded that there was water up to this level. Other evidence on the seaward slopes of the neighbouring hills points to a similar conclusion; but there is nothing to show whether this water was the actual sea- or fresh-water dammed up by ice in the Irish Sea.—H. **Woods**: The Cretaceous faunas of New Zealand. The Cretaceous deposits of New Zealand rest unconformably on older deposits, and in the South Island are usually succeeded by the Amuri Limestone of Tertiary age. Two faunas have been recognised; one of approximately Gault age, the other of Upper Senonian age. Both faunas are of the Indo-Pacific type.—R. I. **Lynch**: Exhibition of the fruit of Chocho *Sechium edule*: remarkable in the nat. order Cucurbitaceæ, native of the West Indies, and cultivated also in Madeira as a vegetable.—G. N. **Watson**: The limits of applicability of the principle of stationary phase.—H. C. **Pocklington**: The direct solution of the quadratic and cubic binomial congruences with prime moduli.—C. E. **Weatherburn**: The hydrodynamics of relativity.—R. **Hargreaves**: The character of the kinetic potential in electromagnetics.—Dr. M. J. M. **Hill**: The fifth book of Euclid's elements. (Fourth paper.)—G. H. **Hardy**: A theorem of Mr. G. Pólya.

DUBLIN.

Royal Dublin Society, February 27.—Mr. R. Lloyd Praeger in the chair.—G. H. **Pethybridge** and H. A. **Lafferty**: Further observations on the cause of the common dry-rot of the potato in the British Isles. In all the cases (thirteen) of dry-rot of the potato tuber examined during the last few years from Ireland, Scotland, and England, *Fusarium caeruleum* (Lib.), Sacc., has been found to be the causative parasite. It attacks the tubers only and does not cause a "wilt" disease of the growing plant. Susceptibility to infection increases with increasing maturity of the tubers. Infection usually occurs through wounds, but can also occur in the absence of them. The fungus also causes a rot in tomato fruits. *F. arthrosporioides*, Sherb., is to be added to the list of species of Fusarium pathogenic to the potato tuber.

MANCHESTER.

Literary and Philosophical Society, January 23.—Prof. S. J. Hickson, president, in the chair.—Prof. G. **Elliot Smith**: The endocranial cast of the Boskop skull. Dr. Péringuey, director of the South African Museum, has submitted for examination and report an endocranial cast obtained from the fossil human skull found near Boskop, in the Transvaal, in 1913. Apart from the right temporal bone, the base of the skull is missing; but sufficient of the calvaria has been recovered to show that the capacity of the cranial cavity must have been well above 1800 c.c., perhaps even as much as 1900 c.c.—greater than that of the philosopher Kant's skull, and almost as large as Bismarck's. The flatness of the cast and certain of its features suggest affinities of the Boskop man with the Neanderthal race. But the larger size, and especially the form, of the prefrontal bulging indicates an even closer kinship with the peoples found in Europe in Aurignacian and later times. The conclusion that seems to emerge from a comparison of the cranial casts of extinct varieties of mankind is that the chief factor which above all others determines brain superiority is not so much mere bulk as the size of the prefrontal area.—Dr. G. **Hickling**: The skull of a Permian shark. A preliminary statement was made concerning the results of a re-examination of certain remains of the skull of *Diacranodus texensis*, Cope, sp., now in the Manchester Museum. The material is sufficient for a practically complete restoration of the cranium and jaws, while there is some indication of the character of the branchial apparatus, not hitherto described.

PARIS.

Academy of Sciences, January 29.—M. A. d'Arsonval in the chair.—H. Le **Chatelier**: Some scientific problems to be solved. Problems awaiting solution are suggested in connection with glass, metallurgy, pyrometry, heating, and agriculture.—Ch. **Lallemand**: A French economic mission in Spain.—Remarks by M. E. **Perrier** on the earlier mission to Spain organised by the Institut de France.—G. **Bigourdan**: The first scientific societies of Paris in the seventeenth century. The Academies of Montmor, Sourdis, etc.—J. **Renaud**: The time on ships. At sea, it is customary to reset the ship's clocks every twenty-four hours to the local noon. Certain inconveniences of this plan are set out, and an alternative method is suggested.—V. **Commont**: The deposits of the historic period superposed on the Neolithic tufa of the valley of the Somme. The marine shells found in these deposits are débris of Gallo-Roman origin and have been carried to their present position by man.—Mlle. Yvonne **Dehorne**: A new species of Stromatopore from the Hippurite chalk: *Actinostroma kiliani*.—H. **Arctowski**: A correlation between magnetic storms and rainfall.—A. **Angot**: Value of the magnetic elements of the Val-Joyeux Observatory on January 1, 1917. The variation of the declination is the greatest that has been observed since the commencement of regular observations (1883).—P. **Sée**: Moulds causing alteration of paper. The moulds, or their spores, are present in new paper, and probably arise from the material used. In spite of the diversity of the material and the experimental conditions, the fungi isolated are always the same and their number is limited. A list of the species is given.—A. **Guilliermond**: Researches on the origin of the chromoplasts and the mode of formation of pigments of the xanthophyll group, and of the carotines.—L. **Bordas**: The *rôle* of the Ichneumonides in the contest against the parasites of forest trees. *Pimpla rufata* renders great service to agriculture by laying its eggs in the bodies of a number of caterpillars. It can be used to prevent or mitigate the ravages of *Tortrix viridana* on oak trees.—J. **Pavillard**: *Pelagorhynchus marinus*.—J. **Amar**: Observations on the prothesis of the lower limb. It is concluded that the prothesis of the lower limb is irrational, and out of harmony with the laws of physiology, of locomotion, and of economy of energy.—G. **Bourguignon**: Normal chronaxy of the brachial triceps in man.—M. **Busquet**: The vaso-constrictive action of nucleinate of soda on the kidney.—A. **Bach**: The non-specificity of the animal- and plant-reducing ferment.—A. **Policard** and B. **Desplas**: Tolerance of the tissue of war wounds in course of cicatrisation for foreign bodies of microscopic dimensions. The mechanism of latent microbism of certain cutaneous scars.

February 5.—M. Paul Appell in the chair.—G. **Bigourdan**: Some ancient observatories of the Provençal region in the seventeenth century. The observatory of Avignon. Sketches of the astronomical work of Bonet de Lates, Tondut de Saint-Legier, Payen, Gallet, Bonfa and Morand.—L. **Lecornu**: The

determination of the legal time. As an alternative to summer time produced by the sudden change of one hour, a gradual method is suggested, reducing the interval between each two consecutive midnights during the spring months by 30 seconds.—E. **Ariès**: The law observed by the four Massieu functions for bodies taken in corresponding states.—R. **Garnier**: The irregular singularities of linear differential equations.—W. H. **Young**: The theory of the convergence of Fourier's series.—Et. **Delassus**: The general notion of movement for holonomial and non-holonomial systems.—E. **Jouguet**: Secular stability.—H. **Villat**: A calculation of resistance in a limited fluid current.—L. **Fabry** and H. **Blondel**: The provisional elements of the planet discovered by M. Sy at Algiers, October 2, 1916. From the calculation of the provisional elements the planet would appear to be new.—F. **Grandjean**: The application of the theory of magnetism to anisotropic liquids.—S. **Meunier**: Complement of observations on the part played by micro-organisms in fossilisation.—A. **Robin**: Comparative analyses of the heart and muscles in healthy and phthisical individuals, with some therapeutic applications.—J. **Cluzet**: New electrical syndromes observed in the wounded.—M. **Ranjard**: Contribution to the study of the diagnosis of war deafness.

BOOKS RECEIVED.

Bengal, Bihar and Orissa, Sikkim. By L. S. S. O'Malley. Pp. xii+317. (Cambridge: At the University Press.) 6*s*. net.

Science and Education: Lectures delivered at the Royal Institution of Great Britain. Edited, with an Introduction, by Sir E. Ray Lankester. Pp. 200. (London: W. Heinemann.) 1*s*. net.

Plants Poisonous to Live Stock. By H. C. Long. Pp. vi+119. (Cambridge: At the University Press.) 6*s*. net.

Cours de Physique. By Prof. E. Rothé. Deux. Partie. Thermodynamique. Pp. xv+328. (Paris: Gauthier-Villars et Cie.) 13 francs.

Peaceful Penetration. By A. D. McLaren. Pp. 224. (London: Constable and Co., Ltd.) 3*s*. 6*d*. net.

Germanism from Within. By A. D. McLaren. Pp. x+363. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Field Crops for the Cotton-Belt. By Prof. J. O. Morgan. Pp. xxvi+456. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—Observations and Experiments on the Susceptibility and Immunity of Rats towards Jensen's Rat Sarcoma: J. C. Mottram and Dr. S. Russ.—Problems Bearing on Residual Affinity: Spencer Pickering.—Residual Magnetism in Relation to Magnetic Shielding: Prof. E. Wilson and Prof. J. W. Nicholson.—The Solar and Lunar Diurnal Variations of Terrestrial Magnetism: Dr. S. Chapman.

ROYAL INSTITUTION, at 3.—Modern Improvements in Telegraphy and Telephony: Prof. J. A. Fleming.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Modern Methods of Finding the Latitude with a Theodolite: Dr. J. Bell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Machine Switching Telephone Gear: F. R. McBerty.

ILLUMINATING ENGINEERING SOCIETY, at 5.—*Discussion*: Fluorescence and Phosphorescence and their Use to Produce Luminous Effects: Opener, F. H. Glew.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 5.30.—Magic in Names: E. Clodd.

PHYSICAL SOCIETY, at 5.—Third Guthrie Lecture: Molecular Orientation: Prof. P. Langevin.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

TUESDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Geological War Problems: Prof. J. W. Gregory.

ROYAL SOCIETY OF ARTS, at 4.30.—Land Settlement in South Australia: The Hon. F. W. Young.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—South Slav Customs and Beliefs as Illustrated in Old Ballads and in Tales by Serb Authors: Miss M. E. Durham.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Decimal System of Coinage, Weights, and Measures: H. Allcock.

WEDNESDAY, MARCH 28.

GEOLOGICAL SOCIETY, at 5.30.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—President's Address: The Earl of Durham, K.G.—Standardisation as Applied to the Machinery for Cargo Boats: D. B. Morison.—A Method of Obtaining for Ship Design the Spacing of Bulkheads according to the Rules of the International Convention: W. J. Lovett. At 3 p.m.—Stress Determination in a Flat Plate: J. Montgomerie.—The Closing of All Ship Side Apertures from the Bridge: Signor E. Benvenuti.—Description of an Apparatus for Interpreting Stability for the Use of Shipmasters: T. Graham. At 7.30 p.m.—The Strength and Inner Structure of Mild Steel: Prof. W. E. Dalby.—Design of Pin Joints based on Ultimate Strength: Lieut. W. A. Scoble.

THURSDAY, MARCH 29.

ROYAL INSTITUTION, at 3.—Telephony: Prof. J. A. Fleming.

AERONAUTICAL INSTITUTE, at 8.—The Necessity for New and Special Treatment of Metals Employed in Aircraft Construction: J. de Kozlowski.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Further Experiments upon Wake and Thrust Deduction Problems: W. J. Luke.—Some Experiments on the Influence of Running Balance of Propellers on the Vibration of Ships: J. J. King-Salter.—Theory of Wave Motion on Water: Sir George Greenhill. At 3 p.m.—Marine Application of Reduction Gears of Floating Frame Type: J. H. Macalpine.—Launching: P. A. Hillhouse and W. H. Riddlesworth.—Buoyancy and Stability of Submarines: Prof. W. Hovgaard.

LINNEAN SOCIETY, at 5.—Prof. T. H. Morgan's Work on the Mechanism of Heredity: W. Bateson.

FRIDAY, MARCH 30.

ROYAL INSTITUTION, at 5.30.—Recent Developments of Molecular Physics: Prof. J. H. Jeans.

GEOLOGISTS' ASSOCIATION, at 7.30.—Cephalopoda, and their Value in Geological Study: W. F. Gwinnell.

SATURDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

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THURSDAY, MARCH 29, 1917.

FISH MIGRATION.

The Migrations of Fish. By Prof. Alexander Meek. Pp. xviii+427. (London: Edward Arnold, 1916.) Price 16s. net.

UNDER the stimulus, and largely by the instrumentality, of the International Council for the Investigation of the Sea, enormous progress has been made in marine biological research in its bearings upon economic fishery problems since the founding of that body in 1902. The lapse of its active functions pending the settlement of the question of the "freedom of the seas" affords a convenient opportunity for considering the general results achieved, and thus the time is ripe for the appearance of Prof. Meek's volume, the material for which has been gathered from the numerous publications of fishery investigators in this and other countries. The book, however, is not merely a compendium or plain digest of other men's work, but possesses an individuality of treatment which is the author's own. While practically all aspects of modern fishery research—or at least their results—are set forth in this treatise, which thus affords far more subject-matter than the title implies, the main theme is the development of a theory of migration at various stages of growth in relation to currents. In this connection Prof. Meek introduces the terms *denatant* and *contranatant*. These are useful words, and will doubtless find permanent employment, but the idea tends to be somewhat overdriven, and the referring of migrations to one or other of these two classes, while satisfying a desire for logical completeness and formal systematisation, is liable to give rise to misapprehension in omitting consideration of all the factors involved in fish migration.

The rather self-evident fact that the pelagic ova and larvæ of fishes will migrate passively in the same direction as the mass of water which constitutes their habitat—or, in the author's terms, will migrate *denatantly*—is a fundamental factor in the distribution of fish species and is rightly emphasised. Also, if A represents the locus of a spawning ground, and B the area to which the passive migration of the early planktonic stages is made and where the individuals grow to maturity, then, if the mature fish return for spawning to their natal area A, the spawning migration from B to A will be against the direction of the current which was responsible for their first passive migration. This is described as a *contranatant* migration. In our opinion this mechanical and frequently misleadingly simple representation of the movements of the older stages leads one very little towards a scientific understanding of the migrations of fishes. The author apparently belongs to that school of ichthyologists who depreciate the value of hydrographical research in relation to the problems associated with fish life. In the preface he says: "It is obvious that currents are importantly associated with migration, but beyond this I have not found it necessary to introduce hydrographical considerations." One may mention the researches of Schmidt and other Scandinavian naturalists upon the migrations of cod, plaice, eels, etc., as demonstrating the fundamental importance of hydrographical factors in determining the spawning migrations of these species, while English investigations also point to the correlation between hydrographical conditions —*i.e.* temperature and salinity of water—and the movements of fishes. It may be that the author considers such correlations insufficiently established as yet; but in ignoring them he would appear, consciously or unconsciously, to dissociate himself from the trend of present-day fishery research.

The omission of reference to food and feeding habits also detracts from the value of this work as a treatise on migration, and further deepens the impression of a too mechanical and pedantically systematised presentation of the phenomena of migration, in terms of which the following is a sample: "The mackerel are denatant migrants in the young condition, and it is evident that the denatant migration is the dominant feature of the migrations when they become mature. It is, as a fact, usually denatant, but in some cases it may be said to be denatant in direction only."

Since the larval stages of practically all fishes are planktonic, the exposition of the idea of denatant migration is carried laboriously, but without any serious hitch, throughout the chapters on the various species. In suggesting that the landward migration of the leptocephalus larvæ of the eel is purely a matter of passive denatant drift, however, the author surely departs from the views of the authorities on the subject. In fact, leptocephali, though doubtless assisted by the drift of Atlantic water towards the European coasts, have quite considerable swimming power.

The distribution and migratory habits of North Sea plaice have been investigated by the international collaborators with a thoroughness and with conspicuously conclusive results which may be said without bias to constitute a monumental fabric of fishery research. These results being available in reports published between 1904 and 1916, it is a drawback that detailed consideration of plaice migrations should have been limited to the relatively insignificant and unrepresentative fraction of the plaice fauna which occurs off the Northumberland coast and in the Firth of Forth.

After the unfortunate quotation from Izaak Walton in the introduction repeating the old but now quite exploded notion that a salmon returns from the sea to the river which it left as a smolt or samlet "usually about six months after," one naturally approaches the chapter on Salmonidæ with shaken confidence. The above erroneous view is repeated on p. 119 in dealing with the definition of a grilse, and the statement that male *smolts* are present on the spawning beds is a misuse of terms. Nor is it correct to assume that female salmon must have spent at least two winters in the sea before spawning, since female grilse are quite common, though not propor-

tionately so numerous as males. Again, in the life of salmon at sea, while growth is more rapid in summer than in winter, it is erroneous to say that feeding is practically confined to the summer.

Regarding purely marine species, the general information is voluminous and authoritative. The author should, however, revise his impressions as to the relative sizes of the two sexes of the conger; the species of the dog-fish pest of the English Channel, which is predominantly *Acanthias vulgaris,* and not *Scyllium canicula;* and the adequacy of the scale-reading method for the determination of the age of haddock.

Notwithstanding what we have criticised as faults of commission or omission in this substantial work, it is one which no one interested in fishery science or desirous of an up-to-date grasp of some of the phenomena underlying practical fishery questions can afford to overlook.

THE PARTITIONS OF NUMBERS.

Combinatory Analysis. By Major P. A. MacMahon. Vol. ii. Pp. xix+340. (Cambridge: At the University Press, 1916.) Price 18*s*. net.

When the first volume of this work was noticed in these columns, the reviewer of that volume expressed the hope that the second would not be long delayed. This hope has been fulfilled, and the reader can now obtain, for the first time, a connected account of all the modern work—so largely due to Major MacMahon himself—which has been done in connection with the partitions of numbers and with allied problems. For the more historical side of the subject the author refers the reader to Netto's "Combinatorik," and he is more concerned to present the newer processes and ideas which lie at the root of the present rapid development of the subject, and have not hitherto found a place in any book. Thus only the earlier sections of the present work overlap that of Netto, and certain investigations which are arithmetical rather than algebraical are dismissed briefly.

It is not possible, in a short space, even to enumerate the many problems of interest which are discussed in this volume—whether problems of analytical development of functions, or problems of a general interest to the non-mathematician, but the solution of which depends on the partitions of numbers. We must perforce confine attention to certain outstanding features, and make no attempt at a summary of the contents of the work.

The introduction contains a list of the memoirs to which reference is made, and the index to both volumes is at the end of the book. Chap. i. begins with Euler's "intuitive" theory of partitions, and gives an account also of the powerful graphical method devised by Ferrers, and used so much by Sylvester. In the next chapter more special attention is given to Durfee's method of studying the graph of a partition, and a very complete set of expansions of generating functions is a notable feature.

The most remarkable of such expansions are the pair discovered intuitively by Ramanujan. Only a few months ago it was found, by Ramanujan himself, that all the arithmetical labour of many mathematicians who have tested one of these expansions, for example, to eighty-nine terms in the supposed default of a real proof, has been wasted, for the theorem was, in fact, proved by Rogers more than twenty years ago, and at the time attracted little attention. Major MacMahon has made some very significant applications of these theorems to a branch of the theory of partitions on which work was scarcely possible before their discovery.

The author has succeeded in basing the theory of partitions upon the theory of Diophantine inequalities. This method is much more fundamental than that of Euler, and its use has rendered the theory of partitions highly general, so that it has now quite lost its earlier character—undoubtedly hitherto the cause of its comparative neglect by mathematicians—of a set of somewhat isolated, though elegant, solutions of special problems. It seems fair to claim, in fact, that we are indebted to the author for a new branch of mathematics, and a branch which must dominate future treatises which make a prominent use of algebraical processes.

Many chapters must be passed over without specific reference, but special mention must be made of those on magic squares, partitions in two dimensions, and the further theory of the Latin square. It is probable that many mathematicians are not aware of the extent to which these subjects have developed, and of the field of work which is still unexplored, and capable of yielding results which are fundamental not alone in connection with the partitions of numbers. By collecting these researches, which are so very much his own, from their hiding-places in scientific memoirs into these two volumes, the author has done much towards the promotion of a more general outlook on the whole range of analytical work usually classed somewhat vaguely as "algebra."

OUR BOOKSHELF.

Nature Study Lessons Seasonally Arranged. By J. B. Philip. Pp. ix+147. (Cambridge: At the University Press, 1916.) Price 2*s*. 6*d*. net.

It is generally agreed that in the early stages science teaching should consist of "Nature study." But it is seldom that teachers realise that this should afford a sound foundation on which later, more serious, study can securely rest. Mr. Philip's little book is a bright and outstanding exception to the general rule. It concerns itself solely with botanical material in its twelve chapters; but the child of from twelve to fourteen years of age who works through its pages in the course of a year will not merely have learnt to observe, but also will have gained a firm grasp of fundamental botanical principles. From the outset the author is at pains to impress the fact that the

organs of a plant are not in mere haphazard positions, but that they occupy definite positions in relation to one another; and that the whole plant is a "living, breathing, feeding, energy-producing organism." The student is thus led on by easy steps to the clear conception of modification of organs, and of homologies; and is thus furnished with a clue by which to solve riddles presented by an apple, a cocoanut, the corm of a crocus, seeds, buds, flowers, etc. Practical work enters largely into the scheme; and by means of questions and exercises the attention of the pupil is frequently directed to the wild plant life of the countryside in a way that is entirely admirable. We cordially commend the book to all teachers of elementary botany. O. H. L.

Poverty and its Vicious Circles. By Dr. Jamieson B. Hurry. Pp. xiv+180. (London: J. and A. Churchill, 1917.) Price 5*s.* net.

DR. HURRY has, in a previous volume, discussed the vicious circles of disease. He now enters the domains of sociology and economics and deals with poverty in a similar manner. "Poverty" he defines as the condition of a person who lacks the necessaries for subsistence and efficiency, and a "vicious circle" is the process by which a primary disorder provokes a reaction which aggravates such disorder. In the ordinary course of economic law the reaction provoked by a social disorder tends to arrest such disorder, but when a vicious circle becomes established the usual sequence is modified, and the reactions which should be beneficent are the reverse and intensify the disorder. As an instance of one of Dr. Hurry's vicious circles we may quote that associated with malnutrition: Poverty leads to malnutrition; this begets debility, which causes diminished earning capacity, and this accentuates the poverty.

The vicious circles of poverty are discussed under twenty-two headings, and a chapter is devoted to "artificial circles," *e.g.* when injudicious relief aggravates the poverty it seeks to remove. The "effects of vicious circles" and the "breaking of vicious circles" form the subject-matter of succeeding chapters.

The book is largely made up of quotations from official reports and from standard authors, and as an outline of the complex subject of poverty should be of considerable value to the student of sociology and economics. It is illustrated with five plates.

Determinacion de la Latitud por Alturas Absolutas, Circunmeridianas, Meridianas é Iguales de dos Estrellas. Por Carlos Puente, Astronomo. (Madrid: Bailly-Baillière, 1917.)

AFTER a short introduction, four chapters of this short manual describe the methods of finding the latitude from altitudes observed outside the meridian, from circummeridian altitudes, from meridian altitudes (this is the longest chapter), and from two different stars observed at the same altitude when the time is known. Each chapter is divided into two parts, the first giving the necessary formulæ, the second and longer part showing how the method is carried out in practice, describing the various instruments (sextant, theodolite, transit circle) and explaining how the instrumental errors are found. Lastly, some auxiliary tables are given. The little book should prove useful to astronomical beginners and travellers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Muscular Inefficiency and Possible Speeds of Walking.

IN walking over a level surface, were there no muscular loss or imperfect elasticity in the ground, the only work to be done would be that required to start the body and limbs at the walking speed, which work might be recovered when stopping. Thus any energy expended in walking on the level is due either to work taken up by the ground, or lost by muscular inefficiency. (Air resistance may be neglected at walking speeds.)

That there is, for each individual, a certain speed at which walking involves a minimum effort is well known; and it seems probable—in fact, almost certain—that this depends on the natural period of the leg about the hip joint. By frequent trials I have found that in my own case this period is about 1·35 sec., so that, since there are two steps to each complete period, the natural number of steps per minute would be about 88; assuming further that each pace is equal to one yard (which is very nearly correct in my own case), the natural speed of walking is 5280 yards, or three miles per hour.

In walking at this pace the accelerations of the masses are effected by gravity.

A pendulum giving 44 beats per minute is 1·46 ft. long, and this corresponds very fairly with the equivalent length of a leg which measures 3 ft. from hip joint to the sole of the foot, taking into account the distribution of mass.

At this speed the only work required is that lost in the muscles or expended on the ground. At any other speeds the muscles are called on to accelerate or retard the various parts, and such work is apparently not recoverable. I do not know of any experiments on this point, but it would be of interest to examine whether, for instance, the muscular effort required to move a body, with a given velocity against a force, is the same as would have to be expended in preventing acceleration when the force is in the direction of motion; or, in other words, whether for equal motions the muscular effort required to cause acceleration is the same as that required to prevent it.

Assuming for the moment that it is, it is possible to calculate the greatest speed at which walking is possible, the speed, namely, at which the mere acceleration of the masses absorbs the whole work of which the muscles are capable.

If, as the simplest supposition, the motion of the leg be represented by the harmonic motion of a mass m, with period T and amplitude a, then—

The energy is $\frac{1}{2}\frac{4\pi^2 ma^2}{T^2}$. When the period is the

natural period (T_0) this energy (except for the loss in extending the muscles and in the ground) is conserved by the action of gravity.

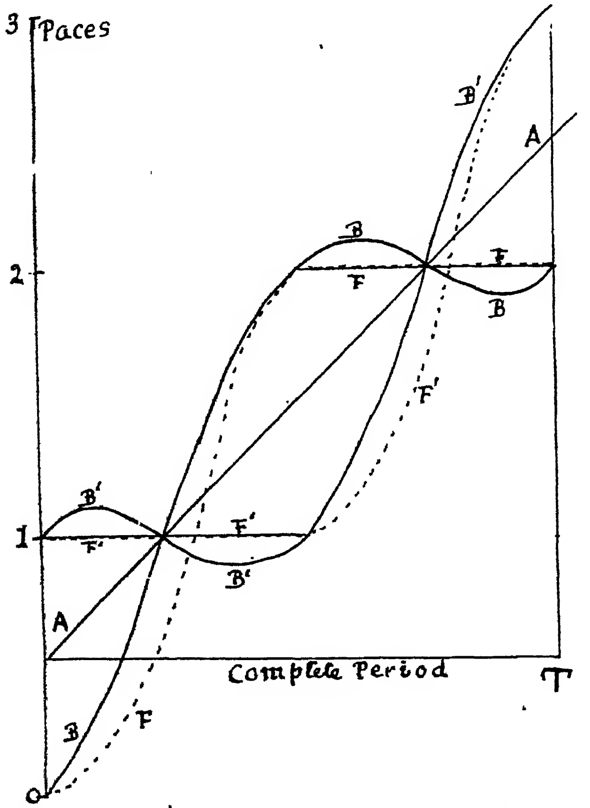

FIG. 1.—AA, motion of body (assumed uniform); BB, trace on ground of right femur (produced); B'B', trace on ground of left femur (produced); FF, position of right foot; F'F', position of left foot.

For any other period (T_1) an amount of energy equal to

$$2\pi^2 ma^2\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right)$$

has to be expended four times in each pace, twice for acceleration and twice for retardation.

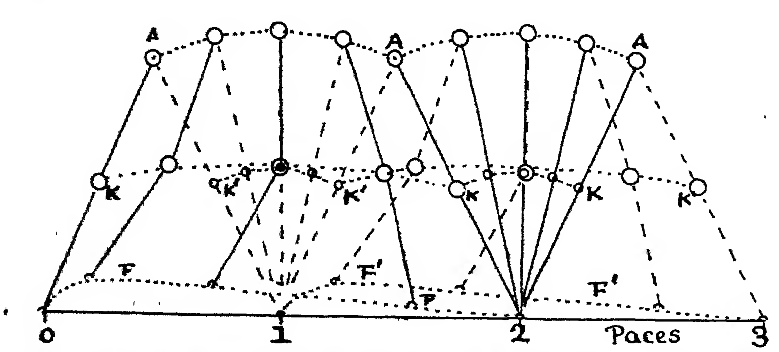

FIG. 2.—AA, positions of hip joints; KK, positions of right knee; K'K', positions of left knee; FF, positions of right foot; F'F', positions of left foot.

Thus for both legs, in each complete period, the amount of energy to be supplied by the muscles is

$$8\pi^2 ma^2\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right),$$

and the power required is

$$8\pi^2 ma^2\frac{1}{T_1}\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right)$$

If $P-Ca$ is the maximum power available (where Ca represents loss from muscular extension), then—

$$\frac{P-Ca}{8\pi^2 ma^2}=\frac{1}{T_1}\left(\frac{1}{T_1^2}-\frac{1}{T_0^2}\right),$$

or, putting $T_1=pT_0$,

$$T_0^3\frac{P-Ca}{8\pi^2 ma^2}=\frac{1-p^2}{p^3}.$$

As a numerical example, assume that $P-Ca$ is 1/10 h.p., or 55 ft.-lb. per sec., also that (as given above) $T_0=1\cdot35$ sec.

The weight of each leg is about 30 lb. (so that $m=1$ nearly). The length of the leg being 3 ft., and that of the pendulum of 1·35 sec. period 1·48 ft., then, since each half pace=1·5 ft., $a/1\cdot5=1\cdot48/3$, or $a=0\cdot74$ ft. nearly.

Thus $$T_0^3\frac{P-Ca}{8\pi^2 ma^2}=2\cdot46\frac{55}{79\times0\cdot55}=3 \text{ nearly},$$

whence $p=0\cdot6$ nearly.

Thus the speed of walking at which 1/10 h.p. is consumed in acceleration would be about 5 miles per hour, or rather more.

This is on the assumption that all the conditions can be represented by one simple harmonic term.

The actual motions[1] in walking, however, are represented in Figs. 1 and 2, and some work must be done in bending the knee joint. The details of this motion vary considerably in different individuals, but in all cases the work required would reduce the maximum walking speed to something a little under 5 miles per hour, which, as a fact, is about the limit for hard walking.

Although the above estimate rests on nothing except common knowledge and casual observation, the result gives a high probability to the assumption that muscular inefficiency, *i.e.* the loss of work in accelerating and retarding their own masses, sets the limit to the speed at which they can be worked.

A. MALLOCK.

[1] In the diagram, for the sake of simplicity, the motion of the body is taken as being uniform. This is not strictly correct, but the difference from uniformity is small.

Gravitation and Thermodynamics.

DR. TODD (NATURE, March 1) suggests that when one gravitative mass approaches another it acquires heat. This might occur when, as is usually (but not always) the case, the body moves up the gradient of potential; for then the energy of field displaced by the body would increase.

There is one development of the above speculation which is not explicitly mentioned by "J. L." (NATURE, March 15), though it may have been inferred. Suppose two cases: (*a*) A metal disc is in a vertical plane at the earth's surface. If it be started spinning on a horizontal axis through its centre the descending half warms and expands, the ascending half cools and contracts, there will arise a turning moment, and the disc will now continue to spin of itself provided the friction is small enough. (*b*) The extreme top and the extreme bottom of the disc will be cold and hot points respectively, so that if metal brushes be applied there, we

could obtain a continuous current in a closed circuit. These are two cases of perpetual motion. The principle of conservation of energy which is here apparently violated is inapplicable to such cases where the forces are so much smaller than any experimental results on which that principle rests.

The temperature effect of gravitation is a residual effect of gravitation which is itself apparently a residual effect, so that we are dealing with forces of, say, 10^{-12} dyne.

The fact that the forces involved in the above suggested cases (*a*) and (*b*) are far too small to render any perpetual effects observable, of course does not affect the argument, which is that the speculation does involve a theoretical continuous motion.

P. E. SHAW.

University College, Nottingham.

Talbot's Observations on Fused Nitre.

SOME years ago in studying the position of the *solidus* curve in the binary system consisting of the nitrates of potassium and sodium, the present writer became well acquainted with the phenomena referred to by Lord Rayleigh in his interesting letter in NATURE of February 1. A number of photomicrographs were made of thin layers of the nitrates, crystallised from fusion, between crossed Nicols and it was found very necessary in the work that the exposures should be made before the secondary change, the arrival of which, as Talbot observed, is hastened by scratching, had set in. There is, of course, now no mystery as to the cause of this secondary change upon cooling in the character of the crystals first formed from the melt, for potassium nitrate is known to be dimorphous, with a transition temperature at ordinary pressure about 129° C. A considerable degree of under-cooling often occurs, and the transition, initiated at Talbot's needle-point, spreads "like a wave" if the slide be cooler than 129°, as Lord Rayleigh found using a temperature near 100°.

If Wallerant is correct in supposing that there is a third, in all circumstances metastable, crystalline variety of potassium nitrate, still further entertainment from this interesting, if old-fashioned, salt is at least possible. ALAN W. C. MENZIES.

Princeton University, Princeton, N.J.
February 24

POSITION AND PROSPECTS OF PROFESSIONAL CHEMISTS.

IN August, 1914, chemists, in common with other professional men, volunteered in considerable numbers for active service with the fighting forces. Many were already attached to the Officers Training Corps of their universities, or to Territorial units—the call was the same to them as to others. The need for fit men was the first consideration, and the need for chemists, as such, in other spheres directly connected with war was not at first recognised. Offers to the War Office of scientific assistance emanating from organised bodies and from individuals were politely acknowledged and pigeon-holed for future reference in case of necessity.

We possessed, fortunately, a number of chemists acquainted with the production of explosives, but as the magnitude of the task before us became better realised a much greater demand arose for chemists to control the operations of manufacture.

In the early months of the war lists of chemists available for the service of the country were prepared by the Institute of Chemistry, the Chemical Society, and other bodies interested in chemical science, with the result that when the Ministry of Munitions called for them a ready response was forthcoming from all parts of the country, from industrial concerns and private laboratories as well as from the universities and colleges, both at home and in the Overseas Dominions. The majority of chemists with experience in the explosives industry were already engaged on war work, and arrangements were made for the training of others to take charge of operations in new factories erected in various parts of the kingdom. Additional chemists were also needed for the increasing work of the staffs of Government laboratories and factories and to control and assist in the production of war material of all kinds. For certain requirements essential to the production of armaments and munitions, for a number of drugs, for laboratory glass and porcelain ware, filter-paper and other necessaries, we had hitherto been almost entirely dependent on Germany and Austria, and this state of affairs would have led to serious difficulties if our chemists had not speedily and successfully dealt with such matters. Students in college laboratories assisted, under the supervision of their professors, in the preparation of drugs and the examination of materials, or left before finishing their courses to take up positions in works. Women science graduates, mostly teachers in time of peace, obtained appointments in analytical laboratories as substitutes for chemists who had joined the forces or been transferred to war work. The demand for trained analysts and works chemists still persists, and has been accentuated by the undoubted fact that manufacturers generally are learning to appreciate more and more the value of science in industry.

In addition to the activities referred to above, mention must be made of the help rendered to the Government by leading consulting chemists, professors of chemistry, and technologists, in an advisory capacity, with regard to inventions and to offensive and defensive measures, wherein many of our best are pitted against the much-vaunted chemists of the enemy. German chemists had obviously devoted attention to the employment of scientific frightfulness in warfare which other nations, if such means had occupied the minds of their men of science at all, would have refused to believe that any civilised people would adopt. British chemists, therefore, were perforce called upon to investigate problems wholly repugnant to their inclinations and degrading to their science in order to fight the enemy with his own weapons. Much of what they have done must remain, and probably will always remain, a sealed book; but the results are shown in the well-deserved praise accorded them in the despatches of Lord French and Sir Douglas Haig.

When the Germans started using asphyxiating gases, the War Office called for volunteers with training in chemistry and formed with little diffi-

culty a new fighting force, selecting the officers from chemists already holding commissions and transferring non-commissioned officers and men with scientific qualifications from other units. Their work did not call for much scientific attainment, yet the force was for the most part made up of graduates and qualified professional chemists, a body of men far too valuable to the country to risk in hazardous enterprise. However, they proved good soldiers and "carried out their unfamiliar duties during a heavy bombardment with conspicuous gallantry and coolness," as reported by Lord French.

Later, the force was augmented, and many of the original corporals were promoted or, as the demand for chemists became more pressing at home, were withdrawn for work in Government and controlled establishments. Chemists were also promptly engaged on research for devising methods of defence against poisonous gases, and for inspection work in that connection.

Apart from measures of offence and defence, however, the work of chemists in the Royal Engineers and in the sanitary companies of the Royal Army Medical Corps engaged on active service for the purification and examination of water and for other sanitary matters, has doubtless contributed to the maintenance of health in the armies on the Continent, in the East, and in Africa, while we must not overlook the fact that not a few of these chemists are also first-class bacteriologists, and their work as such has been indispensable. Mention must also be made of the chemical advisers to the various armies, inspectors of ordnance, instructors in gas defence, chemists with the Army Service Corps concerned with chemical supplies and those attached to the Air Services.

Many of these men have been promoted to high rank, so that we find among them quite a number of colonels, lieutenant-colonels, and majors. One professional chemist who enlisted as a private in the early months of the war has risen to the rank of lieutenant-colonel through his scientific and inventive ability. Comparatively few qualified men who have seen active service have not been afforded the opportunity of taking commissions, and a remarkable number have won honours in the field.

We yet hope to see, however, due recognition accorded others, less in the foreground, who have given loyal service and have materially contributed to the results achieved. We refer especially to chemists working at home, including those in the Civil Service and in Government and controlled factories, the majority of whom we do not doubt would willingly have volunteered for active service had they been permitted to do so. Not a few have worked throughout the war quite gratuitously, while some are in receipt of salaries out of all proportion small in comparison with the responsibility of the duties entrusted to them. There are many chemists attached to different departments of the Civil Service, but few are in receipt of remuneration which would compare favourably with that of men of similar qualifications and attainments engaged in private work or in industry.

The terms and conditions of service offered to qualified temporary assistants in the Inspection Department at Woolwich were, we understand, improved towards the close of 1914, partly as the result of the publicity given to the matter, but also owing to the dearth of candidates for the appointments. Even though the remuneration of 2*l*. 0*s*. 6*d*. a week was increased to 150*l*. a year, and a miserable allowance (about 1*s*. 4*d*. an hour) made for overtime, in the prevailing circumstances the position is distinctly unsatisfactory. If the work is not of a responsible character, the authorities need scarcely be so insistent on high qualifications. We cannot but conclude that such matters have been too much in the control of the clerical establishments, who are ignorant of the significance of chemistry and its vital importance to the interests of the country; yet, perhaps, they are not entirely to blame for the existence of a system prevailing in several places under which, if insufficient financial provision is made for chemical assistants, such men find themselves classified as "foremen" or "draughtsmen," or that some sort of shuffle has been made to bring them within the funds allotted to the expenses of their department.

It is greatly to be deplored that competent professional men have not been graded and treated as such, paid proper salaries, without talk of overtime, and afforded more encouragement generally in the service they render to the State. Now that the Inspection Department is under the Ministry of Munitions we look for a more enlightened appreciation of scientific work. The terms attaching to the appointments of shift chemists in works controlled by the Ministry when they were first decided on were fairly satisfactory for younger men and made allowance for increments up to a moderate limit; but these again call for revision under the altered conditions of living to enable educated professional men to maintain their status and to lessen the sacrifice many of them have made.

In other Government laboratories and chemical establishments many assistants are continuing their work under pre-war rates of pay, and although there is a graded scale of war bonuses we trust their case also will receive due consideration. Throughout the war chemists have made good wherever they have been in request, and we repeat the time has come for a more substantial acknowledgment of their services.

We have already indicated that in industries the demand for chemists is now in excess of the supply, due not only to the fact that so many are with the forces, but also to the growing appreciation of the value of their work and the development of scientific methods of manufacture. The shortage of qualified men has compelled employers to offer better terms, and, as a consequence, a considerable number of teachers have been attracted to works appointments, and in the production of munitions many are engaged as "shift chemists" in charge of plant in factories where scientific control is essential to the safety of the employés. The colleges, at present, have fewer

students than in normal times, but there is much difficulty in securing sufficient lecturers and demonstrators, and, with the professors and heads of departments engaged on war work, the junior staffs are in most cases overburdened. It is doubtful whether many who were teachers before the war will return to their former work, the remuneration and outlook being usually unsatisfactory for any but those of outstanding ability. Yet the majority of our science graduates have hitherto turned to teaching for lack of opportunity of securing appointments in industry, few being in a position to start practice individually.

The private practitioners in chemistry who are really successful are not numerous, and these rely in most cases mainly on consulting and analytical work in some branch in which they have acquired a reputation. The fees for commercial work leave no great margin for the principals when all expenses of maintenance have been taken into account, and they are seldom able to afford high salaries, even to their chief assistants. Much of the routine analytical work is entrusted, as in the factories, to men with no special qualifications. Thousands of men who have received an elementary training in secondary and technical schools are available and can be utilised for a limited range of analyses and comparatively simple operations. The more competent are thereby crowded out.

Reviewing the position as a whole, we come to the conclusion that qualified professional chemists will find in future an increasing demand for their services in industry, either as research chemists, works chemists in control of plant, or works managers, the routine testing work being relegated to the less qualified assistants, only the best of these being eligible for promotion on the works on showing promise of real ability. In progressive concerns arrangements will be made for such assistants to receive systematic training in neighbouring universities and colleges. Works chemists will be wise to take every opportunity of improving their training and experience on the engineering side, whereby they may become capable of designing and erecting plant as required. In the course of time many such men will establish themselves in independent practice, along with public analysts, official agricultural analysts, metallurgists and other specialists, and general consultants.

Appointments in governmental and municipal departments, for which in the higher grades only qualified chemists should be accepted, will probably become more numerous, and should, in the interests of the community, be made attractive to men of the right stamp. Under this head we embrace appointments in arsenals, factories, and dockyards, with those of inspectors under the Alkali, etc., Works Regulation Act, and similar statutory offices, as well as those under county and municipal authorities, health departments, river boards, sewage works, etc., gas examiners, water examiners, and so forth. Chemists engaged in official laboratories should have prospects at least equivalent to those in industry and private practice, a principle which applies in a limited number of the higher appointments of the Civil Service. Nor should we omit the staffs of the National Physical Laboratory, the Imperial Institute, and similar institutions where research is the primary function.

Finally, but by no means the least important, there are the professors and teachers of chemistry, who represent a very large body, engaged in our universities and technical colleges, public and secondary schools, whose positions generally should afford far better prospects than they have in the past. With all these openings there should be no lack of recruits for the profession of chemistry, either in the Mother-country or in the Overseas Dominions, where also competent chemists are afforded opportunities corresponding to those here indicated.

THE WEATHERING OF COAL.

THE Canadian Department of Mines has lately issued a volume of 194 pages, constituting an extra volume supplementing Report No. 83, and forming a portion of the "Investigation of the Coals of Canada with reference to their Economic Qualities," which has been prepared by Dr. J. B. Porter, of McGill University. This is devoted to a discussion of the literature of the subject and of the results obtained by the author and his assistants in their researches upon this difficult and important problem. It has very long been known that whilst all coals are liable to undergo deterioration on storage, some give rise to marked heating, whilst others are even liable to spontaneous combustion. The latter, as being attended with most obvious disastrous consequences, was the first of these effects to attract attention, and a Royal Commission on Coal Cargoes was appointed to study the matter exactly forty years ago. It is only within the last few years that much progress has been made towards its solution, and that mainly through the labours of a few first-class chemists under the scientific guidance of Dr. J. S. Haldane, in a laboratory the expenses of which have been defrayed by the Doncaster Coalowners' Association; this association took up the question from a slightly different point of view, namely, with the object of discovering the causes of, and finding a remedy for, the "gob-fires" to which some coal-seams are particularly liable. Dr. Porter's attention has been directed mainly to the question of the safe storage of coal and the prevention of deterioration in its quality.

It was soon obvious that all these problems are closely related, and depend, indeed, essentially upon the oxidation of coal, and this, again, upon the absorption of oxygen by the coal. Dr. Porter has presented his conclusions in the form of a brief summary, in which he shows that oxidation depends upon the presence of moisture in moderate amount, absolutely dry coal and thoroughly wet coal (*e.g.* submerged in water) being both less liable to oxidation than coal in the presence of a small quantity of moisture; it depends also upon

the rate of admission of oxygen or air, too large a quantity, as well as too small a quantity, checking the oxidising action. He throws but little light upon the part played by the pyrites in the coal, a problem that has not yet been fully solved, but considers that the oxygen is mainly absorbed by the resins and the humus bodies present in the coal.

With respect to the storing of coal, he finds that any coal can safely be stored under water; lump bituminous coal, from which slack and dust have been screened out, can usually be stored with little or no danger; coal stored in the winter is less likely to give trouble than if stored in the summer, and in the latter case it is best if cool or cloudy days are selected; shallow piles are less likely to give trouble than deep ones; some coals, particularly those high in sulphur, undoubtedly heat more readily when damp; the ventilation of coal piles by means of perforated pipes or otherwise is very advisable; and, finally, a coal storage pile should be carefully watched, particularly for the first few weeks after it has been built.

The report is worthy of careful study, and forms a notable contribution to a subject of the greatest importance to coal producers and coal users alike, and at least as much so in this country as elsewhere.

It is significant of the British attitude towards the scientific investigation of such economic problems of great national importance that in Canada they are attacked by State institutions subsidised and supported by the State authorities, whilst in this country the work is left to private individuals and to private resources. Is it too much to hope that the attention of the Committee of the Privy Council for Scientific and Industrial Research may be directed to the admirable work done in Canada, and that it may decide that the time has at last arrived to initiate something of the kind in this country?

REV. O. PICKARD-CAMBRIDGE, F.R.S.

FEW, whatever their nationality, who have been especially interested in spiders during the last forty years have failed to make the pilgrimage to Bloxworth, where the Rev. O. Pickard-Cambridge, who died on March 9, had been rector since 1868, and to enjoy the delightfully informal hospitality of the Rectory. The famous "den" was no doubt their first objective, but those who were privileged to walk with their host in the surrounding country must have realised that they were in the company of a born naturalist of the widest sympathies, keenly observant, and on the friendliest terms with every living thing—beast, bird, insect, or plant—encountered by the way. There can have been few naturalists of equal calibre less revealed by their published work. This in his case was almost exclusively systematic, and was concerned for the most part with a single Arachnid order, the Araneina. It is true that he was selected to write the article "Arachnida" for the ninth edition of the "Encyclopædia Britannica" (1875); that he published useful little monographs on the British Phalangids and Pseudoscorpions (1890 and 1892); and that he occasionally described a tick or a Tartarid; but these were excursions, and through a long series of years his leisure was devoted mainly to the identification and description of spiders.

This most useful and necessary work does not stand very high in the estimation of some zoologists, though it is noticeable that a worker in some other field—a morphologist, for example—forced by stress of circumstances to try his own hand at identification, soon acquires an added respect for the necessary qualifications. In any case, it is on his work as a systematist that the reputation of Pickard-Cambridge is solidly based. His natural *flair* for minute points of difference, his facility as a draughtsman, his tireless patience, and his unflagging enthusiasm through a long series of years were his equipment for his self-imposed task. The mantle of John Blackwall fell upon him. He set himself to continue Blackwall's work, and to him he dedicated, in 1881, his most important book, "The Spiders of Dorset," "as a small token of long friendship and respect, as well as of gratitude for constant and ready assistance in the study of spiders during the last twenty-five years." This book (its title is altogether too modest) still remains essential to the student of British spiders, supplemented by the papers since annually published by its author in the Proceedings of the Dorset Field Club, and by his "List of British and Irish Spiders" (1900).

As regards exotic species, Mr. Pickard-Cambridge published brochures on spiders collected by himself in Palestine and Egypt (Proc. Zool. Soc., 1872–4–6), and on collections by members of his family, private friends, or scientific expeditions from various regions; but his chief work in this field was in connection with the "Biologia Centrali Americana." The task of dealing with the mass of material involved proved eventually beyond his powers, and failing health obliged him to hand it over to his nephew, the late Frederic O. Pickard-Cambridge, but he continued his work on the native Arachnid fauna until the end.

Many will miss the help he was always eager to give to those who applied to him for information or advice, and not a few will mourn the loss of a picturesque and interesting personality.

NOTES.

THE annual meeting of the British Association, arranged to be held at Bournemouth in September next, has been cancelled; and there will be no meeting, therefore, this year. The two main considerations which have led to this decision are the restriction of railway communication and difficulties of accommodation on account of buildings being required for various national purposes. There will probably be a meeting of the General Committee of the association in London to receive reports and transact other business.

IT is refreshing to note that some of the museums of this country, by making themselves of immediate use, are justifying the authorities who have kept

them open. The Leicester Museum, which led off with the first public exhibition of mothercraft, is now seeking by means of models to aid those who find themselves handling a spade for the first time and have yet to learn that a potato has two ends. Norwich Museum, which also had its mothercraft show, has opened a thrift and economy exhibition. Food values, cheap cooking, home-washing, thrift garments, fuel economy, saving of man-power, and the cultivation of potatoes are among the subjects dealt with. It seems to us that the rate-supported museums are quite the proper instruments for the education of the public in these homely ways of helping the country, and we hope that more will follow the example of Leicester and Norwich.

SIR J. WOLFE BARRY is to deliver the "James Forrest" lecture to the Institution of Civil Engineers on Wednesday, May 2, taking as his subject, "The Standardisation of Engineering Materials and its Influence on the Trade and Prosperity of the Country."

NEWS has just reached us of the death on February 6, at sixty-three years of age, of Dr. H. F. E. Jungersen, professor of zoology in the University of Copenhagen and director of the department of vertebrates in the University museum.

THE death is announced of Col. Walter Katte, the civil engineer who built the elevated railways of New York. He was born in London in 1830, and was educated at King's College School. He emigrated to America in 1849. At the outbreak of the Civil War he commanded an engineer regiment. He superintended the construction of the first steel-arch bridge to span the Mississippi.

ANOTHER national park has been set apart by vote of the American Congress. This new reservation has an area of 2200 square miles, and lies in south-central Alaska. It contains within its boundaries the highest mountain in America, Mount McKinley, and will consequently bear the name of the Mount McKinley National Park. As a game refuge and breeding-ground the park is expected to preserve Alaskan game, which elsewhere is rapidly disappearing.

THE expedition which the American Museum of Natural History has maintained for the last six months in Nicaragua has returned to New York, bringing with it a collection of 1500 fishes and 2000 reptiles, together with a large series of photographs and unusually complete œcological notes. The material thus obtained is said to be of special value, as no specimens of reptiles have ever before been brought out of this region, although it has a reptile fauna of no ordinary interest, not only because of the great diversity in the topographical features, but also because the isthmus to-day forms a transition tract between the two continents, and is supposed in the past to have had land connection with Cuba and Jamaica. The expedition was in charge of Mr. C. R. Halter, an assistant in herpetology at the museum, and Mr. L. A. Mannhardt, of Yale.

WE learn from the *Times* that it has been decided to introduce summer time this year, as recommended by the Home Office Committee, throughout the United Kingdom, beginning at 2 o'clock in the morning of Sunday, April 8, when the clocks will be put forward one hour, and ending at 2 o'clock in the morning of Monday, September 17. An Order in Council will be issued to give effect to this decision. The Rome correspondent of the *Times* announces that summer time will be adopted in Italy on April 1, and will remain in force until the end of September. Under the Daylight Saving Act, clocks in Australia were put back one hour on Sunday, March 25.

THE annual general meeting of the Ray Society was held on March 22 in the apartments of the Geological Society, Dr. S. F. Harmer, in the absence of the president, being in the chair. The report of the council showed a slight increase in the membership, a large increase in the sale of publications, and a very satisfactory balance-sheet, and stated that two volumes had been issued for 1916, and the issue for 1917 would be the "British Characeæ" by Mr. James Groves and Canon Bullock-Webster. One of the rules was amended so as to require authors to agree to assign the copyright of their works to the society. Vacancies on the council were filled by the election of Sir David Prain and Dr. A. B. Rendle. Prof. W. C. McIntosh was re-elected president, Dr. F. Du Cane Godman treasurer, and Mr. John Hopkinson secretary.

THE President of the Board of Trade has appointed a committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development. The members of the committee are:—Mr. F. Huth-Jackson (chairman), Mr. H. Booth, Mr. J. Devonshire, Mr. J. Falconer, Mr. G. H. Hume, Mr. J. Kemp, Mr. H. H. Law, Mr. C. H. Merz, Sir Charles Parsons, Sir John Snell, Alderman C. F. Spencer, and Mr. A. J. Walter. The secretary of the committee is Mr. M. J. Collins, to whom all communications on the work of the committee should be addressed at the Board of Trade, 7 Whitehall Gardens, London, S.W.1.

THE President of the Board of Agriculture and Fisheries has appointed a committee to consider practical means for increasing the supplies of sea-fish for the home markets and for encouraging the consumption of such fish, whether cured or fresh, in substitution for other foods. The committee has received a grant from the Development Fund, with authority to expend the grant, subject to limitations and conditions recommended by the Development Commissioners and approved by the Treasury, at their discretion for the increase of the fishing power of vessels other than steam fishing vessels. In general their expenditure will be confined to assisting fishermen who are owners of their own boats to develop their fishing power and to secure greater quantities of fish. The committee consists of:—Mr. Cecil Harmsworth (chairman); Mr. H. S. M. Blundell, of the Admiralty War Staff (Trade Division); Mr. H. G. Maurice, of the Board of Agriculture and Fisheries; Mr. E. H. Collingwood, of the Board of Agriculture and Fisheries; Mr. Stephen Reynolds, representing the Development Commissioners; Mr. A. Towle, representing the Food Controller. The secretary and manager is Mr. G. K. Hext. Communications should be addressed to the secretary, Fish Food Committee, 43 Parliament Street, S.W.1.

THE President of the Board of Agriculture and Fisheries has appointed a committee to consider whether any considerable addition to the home food supplies of fish could be provided from the rivers, lakes, and ponds of England and Wales. The committee is requested to have special regard to considerations affecting the practicability of any scheme for bringing fresh-water fish supplies into consumption, such as the machinery and labour required to make the supplies available, facilities for their transport to market,

the food value of the different kinds of fish, the probability of its proving acceptable to the consumer, the necessity for interference with private rights, and the risk of damage to more valuable fisheries. Further, the committee will consider and report upon measures which might be taken for securing a greater output of eels from the waters of the United Kingdom for home consumption. The members of the committee are:—Lord Desborough (chairman), Mr. R. B. Marston, Mr. A. R. Peart, Mr. F. G. Richmond, Mr. H. T. Sheringham, Mr. A. Tate Regan, Sir John Wrench Towse. The Hon. A. S. Northcote will act as secretary to the committee. All communications should be addressed to the secretary, Fresh-water Fish Committee, 43 Parliament Street, S.W.1.

Mr. E. Heron-Allen devoted his recent address as president of the Royal Microscopical Society to an elaborate account of the career and observations of Alcide d'Orbigny, the founder of our knowledge of the Foraminifera (Journ. Roy. Microscop. Soc., 1917, part i.). Alcide's father, Charles d'Orbigny, a doctor at Esnandes, near La Rochelle, initiated the studies which made his son's name immortal. Félix Dujardin, moreover, in 1835, not ten years after the publication of d'Orbigny's "Tableau méthodique," first appreciated the simple nature of the foraminiferal organism, and removed the group, which he styled Rhizopoda, from any alliance with the Mollusca. But d'Orbigny's skill in minute observation, in collation, and in delineation makes a permanent claim upon our gratitude, and Mr. Heron-Allen proposes to publish, when peace returns, the remarkable series of "planches inédites" that he has brought once more to light in the museum at the Jardin des Plantes in Paris. Two coloured examples of these beautiful plates accompany the address, and the other illustrations add touches of human interest to what has become, in its author's hands, a genuine biographical and bibliographical research.

The *Atti dei Lincei* (xxvi. (1) 1) contains an account of the work of Prof. Angelo Battelli, whose death, at the age of fifty-four, occurred on December 11 of last year. Born in 1862, Battelli entered the University of Turin at the close of his school career, and by 1884, when he graduated, he had already qualified for substantial researches in physics. His earliest interest was in thermo-electricity, in which he made the first determination of the so-called "specific heat" of electricity. The Peltier effect was the subject of repeated experiments, and he described an arrangement in which reversal took place at a moderate temperature. Later researches dealt with the effects of pressure on the temperature of fusion and that of magnetism on thermal conductivity, as well as on thermoelectric effects. In 1887 Battelli commenced an extended series of investigations on the critical point, the density of saturated vapours, and of liquids at the maximum vapour pressure, specific heats, and allied phenomena. In particular, he traced the isothermals in the neighbourhood of the critical point. In 1898 he gave his attention to the study of oscillatory discharges and the attendant phenomena. He was also the author of a number of books, including some textbooks, besides works of a more substantial character, on electrolytic dissociation and radio-activity. On his appointment at Pisa, Battelli found the physical laboratory quite inadequate, both for instruction and for higher studies, and it became necessary for him to get it properly equipped. He also took an active part in educational discussions in the Italian Second Chamber. The author of the notice, Dr. A. Naccari, expresses the opinion that his end was accelerated by his constant activity, which he would not allow to flag even in his last sad illness.

The twenty-sixth annual meeting of the Royal Society for the Protection of Birds was held at the Middlesex Guildhall on March 22, her Grace the Duchess of Portland, president, being in the chair. As might be supposed, the war has adversely affected the work of the society, though not to any serious extent. It was mentioned that the large camps now scattered over the country have often, inevitably, invaded areas under the protection of the society. But the damage done, it is hoped, will be less than was feared, for in many cases the men were induced to take an interest in the birds, and thus reduced the damage to the lowest possible limits. The work of the society's watchers, all of whom are ineligible for military service, has for the most part gone on successfully, and some interesting items have been recorded. We are glad to note that the breeding season of 1916 was highly successful in the case of the Kentish and Norfolk plovers, chough, phalarope, peregrine falcon, and buzzard. The gannet nested for the first time on Noss, in the Shetlands; the redshank for the first time on one of the Cumberland lakes; while the great skua has spread to a new region. A strong expression of opinion that the recent prohibition of the importation of plumage during the war should find a permanent place on the Statute Book was warmly supported. For it was pointed out that otherwise the work of the plume-hunters would still go on, their ill-gotten gains being hoarded until after the war, when they would be dumped upon the market. The Dutch Committee for the Prohibition of the Exportation of Birds and Bird-skins from Dutch Colonies was very emphatic on this point. A number of valuable leaflets on the need for the protection of insectivorous birds has been issued by the society for distribution, and these should be widely read.

The following are the lecture arrangements at the Royal Institution after Easter:—Prof. C. R. Beazley, two lectures: "Russian Development": (i) "The Old Free Russia," (ii) "The Rise of Moscow"; Prof. C. S. Sherrington, two lectures: (i) "Tetanus: Its Prevention, Symptoms, and Treatment," (ii) "Rhythmic Action in Muscle and in Nerve"; Prof. D'Arcy W. Thompson, two lectures: "Architectural Design in Organisms," "The Laws of Growth and Form"; Prof. W. W. Watts, two lectures: "The Flow of Ice and of Rock"; Prof. H. S. Foxwell, two lectures: "Industrial Finance after the War"; Prof. Gilbert Murray, two lectures: "Pagan Religion at the Time of the Coming of Christianity"; Prof. W. Bateson, two lectures: "The Chromosome Theory of Heredity and the Alternatives"; Alfred Noyes, two lectures: "Modern English Poetry"; Prof. G. H. Bryan, two lectures: "Principles of Aerial Navigation"; Sir J. J. Thomson, six lectures: "The Electrical Properties of Gases." The Friday evening discourses, which will begin on April 20, include:—Prof. R. H. Biffen, "The Future of Wheat-growing in England"; J. Dundas Grant, "The Organs of Hearing in Relation to War"; H. Wickham Steed, "Some Guarantees of Liberty"; Prof. John Joly, "Radio-active Haloes"; Prof. F. Soddy, "The Complexity of the Chemical Elements"; J. Barcroft, "Breathlessness"; J. H. Balfour Browne, "The Brontës: a Hundred Years After"; Sir J. J. Thomson, "Industrial Applications of Electrons."

"The War and Our Supply of Drugs" was the subject of a paper read before the Royal Society of Arts recently by Mr. F. A. Hocking. Out of about eighty drugs of vegetable origin in use at the London Hospital during 1914, only a few are drugs ordinarily derived from enemy countries, the chief being aconite, belladonna, colchicum, digitalis, gentian, henbane,

opium, and possibly valerian. After the outbreak of war the main difficulties were in respect of the supply of belladonna, henbane, and valerian. The needs are now being met partly by products grown in this country and partly by drugs obtainable from abroad. Thus India supplies opium, Japan aconite and valerian, and Egypt henbane. Of the alkaloids and their salts, seven out of the fifteen used in the hospital were, and of course still are manufactured here on a large scale, both for home use and for export. The remainder were obtained from enemy countries. Of the acids and their salts, the majority are home products, but in some cases the raw materials, especially potassium and bromine, were either in enemy hands or under neutral control, with the result that their prices rose enormously The most important of manufactured organic drugs, such as ether, ethyl chloride, chloroform, iodoform, carbolic acid, glycerine, and alcohol, are produced here in large quantities; but most of the synthetic drugs, like aspirin, phenacetin, salvarsan, and veronal, were German products. Many of these articles, however, are now being made here. On the whole, for our drug supplies we are much less dependent upon enemy sources than has generally been recognised. The author, indeed, suggests that the necessity for the home cultivation of medicinal plants has perhaps been over-emphasised, since the demand for belladonna and digitalis is strictly limited.

IN No. 7, second series, of the Bankfield Museum Notes, Miss L. E. Start publishes a monograph on Burmese textiles from the Shan and Kachin districts, based on a collection of examples made by Mr. E. C. S. George, at the end of last century, whilst he was engaged on the Commission for the delimitation of the Burma-China boundary. The monograph is illustrated by an excellent collection of drawings showing the modes of dress and the forms of ornamentation used by the native weavers. The illustrations to some degree suffer from the absence of colour, but designers of fabrics, who can examine the original specimens in the Bankfield Museum, will be well advised not to neglect this important collection of Oriental art, which may enable them to follow some of these graceful designs, and prepare new schemes of decoration suitable to the native races of Burma.

MR. J. H. GURNEY makes grave charges against the rook and the wood-pigeon in *British Birds* for March. As to the former he remarks: "It has always seemed an anomaly to me that hawks in Norfolk, and even owls, should be persecuted, while rooks go almost unscathed, although there is not a farmer who has a good word to say for them." They eat potatoes and newly sown grain, riddle the cornstacks with holes and thus admit the rain, and destroy a large quantity of swede turnips. The wood-pigeons levy a heavy toll on the thousand-headed kale and on the pea-fields. The starling, in Norfolk, is tolerated on account of its usefulness in destroying the white slugs, which infest the clover-fields.

INTERESTING "Observations on Some Habits of the Coot" are described in the *Scottish Naturalist* for March. These more especially refer to the behaviour during courtship. At this time the white shield, so conspicuous a feature of this bird, enlarges so as to project on each side of the crown. But the author leaves the reader in some doubt as to whether this is a permanent increase during the breeding season or whether it is an inflation evident only during moments of excitement, comparable to the distension and contraction of the wattle of the turkey-cock in similar circumstances. The adults were found to be still feeding their offspring two months after hatching, and therefore long after they had become fully fledged. During October the male frequently gave the "spring call," and the pair frequently repeated the behaviour characteristic of the spring courtship, as many game-birds are known to do.

A VALUABLE contribution to our knowledge of the genetics and evolution of an interesting group of Lepidoptera is given by J. W. H. Harrison in a recent paper entitled "Studies in the Hybrid Bistoninæ" (*Journal of Genetics*, vol. vi., No. 2). The species with which he has worked are the common British moth (*Biston hirtaria*), the well-known local sandhill-haunting *Nyssia zonaria*, whose female is wingless, and four species of the northern genus Poecilopsis, one of which, *P. lapponaria*, is a rarity in Scotland. The Biston males, if successfully crossed with the wingless females give winged males, and females with reduced wings, and closely similar results followed the pairing of *P. pomonaria* males with *Biston hirtaria* females. Hence, "as regards potency in transmitting the secondary female character of wing-reduction, *pomonaria* males and females are alike." Two of these male *hirtaria-pomonaria* hybrids were successfully crossed with *hirtaria* females. With one exception, all the offspring were indistinguishable from *hirtaria*, a result explained by the production of "a few functionally active spermatozoa carrying to all intents and purposes *hirtaria* characters, with hosts of spermatozoa carrying a varied array of novel chromosome combinations, all possibly ineffective." However, there was a single intermediate specimen which "lacked the sexual instincts and was unable to walk or to fly." Mr. Harrison notes that the North American *Poecilopsis rachelae*, when crossed with the European species, gives a very small proportion of fertile eggs and concludes that "geographical separation caused the physiological condition of the species to diverge enormously."

VARIOUS schemes for the promotion of afforestation in Scotland, by co-operation between the landowners and the State, are discussed in three articles in Transactions Roy. Scottish Arboricultural Society, xxxi., part i. (January, 1917). The Development Commissioners, who have lately forwarded their proposals for afforestation and land reclamation to the Reconstruction Committee, do not favour the purchase of land by the Government, but recommend that it should be taken on lease, the landowner to receive, in addition to a rent, a bonus or percentage on the profits of the undertaking. Mr. S. Gammell advocates a scheme of planting by the landowner, who would receive from the State a loan for this purpose, to be repaid, after the lapse of a period of forty years, in twenty annual instalments, calculated on compound interest at 2½ per cent. Mr. James W. Munro gives an illustrated account of the life-history of *Hylastes cunicularius*, a beetle which destroys recently planted conifers by girdling the bark just below the root-collar.

THE *Revue Scientifique* of March 3 contains an article by Prof. Henri Devaux, of Bordeaux, in which the attention of French wheat-growers is directed to the excellent results obtained by him with special methods of cultivation of wheat which are said to be widely and successfully practised in Russia. The two methods singled out for special commendation are the planting out of selected plants from a seed-bed, and the cultivation of the wheat in wide rows, permitting of an earthing-up of the plants at a later stage. It is claimed that by either method a very much larger individual plant can be obtained, and the total produce of a given area greatly increased. Full details for practical cultivation on these lines are given, and the article is illustrated by photographs of specimen plants.

These methods have previously been advocated in this country, and are worthy of investigation, but the obvious increased demand for labour as compared with ordinary methods of cultivation must render them largely impracticable for adoption under present conditions.

THE *Irish Naturalist* for March contains the annual report of the Royal Zoological Society, from which it is clear that the society has passed through a very troublous year, and one which came dangerously near to disaster. During the week of the Easter rebellion the difficulty of conveying food for the larger carnivores to the gardens was so great that some of the less valuable stock had to be sacrificed, including "an old pony, a donkey, a goat, and a few dingoes." These had to go to feed the lions and tigers. The keepers, for the time, had to be housed in the gardens owing to the danger of venturing into the streets of Dublin. Further, owing to the social unrest, the receipts for the month practically ceased. This loss, with the falling off of revenue owing to resignation of subscribers, has seriously crippled the society, but, fortunately, thanks to the generosity of some of its members, the deficit at the end of the year was much less than at one time seemed inevitable. The young female gorilla, we are glad to notice, is not only still alive, but is, further, in better health than was the case when the report for 1915 was issued. During midsummer a female bison calf was born and is still thriving. For the first few weeks it was of a bright red colour, but has now assumed the typical dark coat.

THE plans of a projected aerial expedition to New Guinea by Dr. Eric Mjöberg, of Stockholm, are outlined in the February issue of the *Geographical Review* (vol. iii., No. 2). In view of the great difficulties presented by climate and vegetation in reaching the mountains of the interior, Dr. Mjöberg proposes to use aeroplanes or even hydroplanes. He considers that the interior will afford four different possibilities of landing: alpine meadows at 12,000–13,000 ft., open or thin savannas at lower altitudes, steppes of *alang* grass known to occur here and there, and lake surfaces. These last are not certain to occur. A reconnaissance is first to be made with a light machine. Then a heavier machine capable of carrying five passengers and stores is to leave the base for the interior. Subsequent communication would be maintained between the coast and the interior stations of the expedition in a few hours' time. Dr. Mjöberg proposes to take with him two surveyors, a botanist, a zoologist, and a geologist, besides several expert airmen.

THE annual report of the Weather Bureau of the Manila Observatory for 1915 has been published. It contains the full hourly meteorological observations made throughout the year. In addition to the central observatory at Manila, the Weather Bureau maintained fifty-six other stations throughout the Philippines, and one at Yap, in the western Carolines. There seems, however, to be some doubt whether the station at Yap has been maintained in working order since the change in ownership of the Carolines. The lack of communication with Yap interfered with the typhoon warnings sent out by the Manila Observatory. The volume directs attention to the fact that the Manila Observatory has now been in existence for fifty years.

MESSRS. KODAK, LTD., have just issued an illustrated booklet on "Kodak Bromide Pictures, by Some who Make Them," a collection of seven articles, supplemented by the firm's own instructions. Though obviously of chief interest to those who use bromide papers for pictorial purposes, there are suggestions that may be of much wider utility, and the illustrations show what a great range of possibilities is offered by this method of printing. The scientific worker will need, however, to add to these the results obtainable on papers that have a glossy surface, which emphasises feeble and minute details, and will note the "transferotype" paper which permits of the film that bears the image being transferred to surfaces such as those of glass, porcelain, wood, metal, canvas, etc.

CERTAIN species of lichens have long been used by the inhabitants of Ireland, Scotland, and other parts of Northern Europe for dyeing wool various shades of yellow or reddish-brown. Four of these lichens, *Parmelia saxatilis*, Ach., *Ramalina scopulorum*, Ach., *Ramalina cuspidata*, Nyl., and *Physcia parietina*, De Not., have been examined by Dr. Hugh Ryan and Mr. W. M. O'Riordan (Proceedings of the Royal Irish Academy, 1917, xxiii., Section B, pp. 91–104) with the view of isolating their tinctorial constituents. The first three lichens were submitted to a preliminary extraction with ether. By this means a colourless, crystalline substance was obtained from *Parmelia saxatilis*, probably identical with Zopf's stereocaulic acid, whilst *Ramalina scopulorum* and *R. cuspidata* gave Zopf's *d*-usnic acid. After the treatment with ether the three lichens were extracted with boiling acetone. By this means a colourless, crystalline substance, apparently identical with Zopf's salazinic acid, was obtained from *Parmelia saxatilis*. The lichen *Ramalina scopulorum* gave a white, microcrystalline substance probably identical with Zopf's scopuloric acid, whilst *R. cuspidata* also yielded a white, crystalline substance, which, however, was not identified with any known compound. That these three substances are the tinctorial constituents of the respective lichens is shown by the fact that when wool is boiled with water containing them it is dyed in a manner similar to that produced by the lichens. *Physcia parietina* when extracted with chloroform gave a quantity of physcione (probably identical with frangula-emodin-monomethylether), which has little or no dyeing properties, but which when demethylated gives frangula-emodin. The latter dyes unmordanted wool a dull orange-yellow colour.

A USEFUL catalogue (No. 67, March) of books of science (many of them scarce) has been issued by Messrs. Dulau and Co., Ltd., Soho Square, W.1, which should appeal to many of our readers. It is arranged conveniently under the headings Botany and Horticulture, Geology and Palæontology, Entomology (with subdivisions), Ichthyology, Mammalia, Mollusca and Conchology, Ornithology, Reptilia and Batrachia, and Scientific Voyages and General Zoology.

OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF N.G.C. 7023.—Dr. Max Wolf has previously pointed out that many nebulæ in the Milky Way are encircled by a nearly circular space which is void of faint stars, and that this lacuna is usually situated at the end of a long, starless channel. Such nebulæ are designated "Höhlennebel," or "cave-nebulæ," and Dr. Wolf has recently given an account of spectroscopic observations of some of them which have been made at Heidelberg (*Ast. Nach.*, No. 4875). One of the finest examples is H. IV. 74 Cephei (N.G.C. 7023), in which the cave has a diameter of nearly half a degree, and the nebula surrounds the star B.D. + 67° 1283, of magnitude 6·8. The photographs show that the star is of type A, and that the spectrum of the nebula exactly resembles it, without showing any trace of the lines characteristic of gaseous nebulæ. It

is therefore highly probable that, as in the case of the ρ Ophiuchi nebula described by Sliphér (Nature, vol. xcviii., p. 236), the nebula shines by reflected light of the star which it encloses. Other nebulæ have also been investigated, and some of them show feeble traces of bright nebular lines in addition to continuous spectrum. Very long exposures were of necessity given in taking the photographs, and it is still uncertain to what extent the photographed spectrum is influenced by light of the associated star which is diffused in the earth's atmosphere.

Imperial Astronomical Society of Russia.—A cordial welcome will be extended to the bulletins of the Imperial Astronomical Society of Russia, the first number of which has recently been distributed. It contains a series of notes by M. Viliev, including an ephemeris of the planet (67) Asia, a search ephemeris of comet 1846 IV. (De Vico), and a note on the possible return of the comet of 1532. In opposition to Olbers, M. Viliev finds reason to believe that the comet of 1661 may have been a return of that of 1532, in which case its reappearance would be due about the present time; it remains, however, to make a new reduction of the observations made by Hevelius in 1661, and to calculate the perturbations during the three revolutions. A further note refers to the central line of the total eclipse of the sun of May 28–29, 1919. One of the notes is in English, and the remainder in French.

Monthly Star Maps for 1917.—In response to requests from naval and military officers and others, the annual publication of the Scottish Provident Institution has again taken the form of a star atlas and astronomical calendar, which has been prepared for the twentieth year in succession by Dr. Blaikie. In addition to the monthly maps, showing the stars in the now familiar gold on dark blue, there is a stereographic projection intended for the solution of many problems for which the celestial globe is ordinarily employed. There are the usual tables relating to the sun, moon, and planets, and these, together with the interesting series of explanatory notes, form an admirable popular guide to the heavens. This publication has doubtless done much to encourage a general interest in observational astronomy, and its usefulness in this respect might be increased if it were made available to anyone who was prepared to pay for it.

SCIENCE LECTURES TO THE TROOPS IN FRANCE.

At the invitation of the War Office, the Young Men's Christian Association recently organised a special service of lecturers to visit suitable centres in France for periods varying from a fortnight to three months or more in order to provide the troops behind the line with recreation of a thoughtful kind. The lectures were arranged because of a desire expressed by many of the troops for occasional entertainment of a more solid or instructive character than is offered by moving pictures and concert parties. Their aim has been not merely to afford amusement to the men in their unoccupied hours, but to give an understanding of the causes and aims for which our troops are fighting, and to deal with military, naval, and political history, with science, literature, travel, and other subjects of general interest. The scheme has received the hearty support of the universities, the vice-chancellor of each of which has appointed a special committee to nominate lecturers. The details of arrangement have been in the hands of Prof. Gilbert Murray for the War Office Educational Committee and of Mr. Basil Yeaxlee for the Y.M.C.A.

In connection with this scheme a number of lectures upon scientific subjects have been, and are being, given at base camps and other centres in France. Among the science lecturers who have already completed their courses are Prof W. Bateson, Prof. Alex. Findlay, Prof. R. A. Gregory, Mr. J. Humphreys, Prof. O. T. Jones, Rev. T. E. R. Phillips, Prof. E. B. Poulton, Mr. W. E. Whitehouse, and Dr. F. Womack. Lectures have been given to the officers as well as to the men upon such subjects as heredity, chemistry of daily life, the sun, moon, planets, and stars, primitive astronomy, protective resemblance, war among animals, the life of a river, rocks and soils of northern France, the Great Ice Age, climate and vegetation, mechanical contrivances of plants, and so on.

The lectures are given in Y.M.C.A. huts, and are usually illustrated with lantern-slides. They have proved remarkably successful, and in most cases the huts have been filled with men who listened with attention and intelligent interest to simple discourses upon natural facts and phenomena and their scientific interpretation. Even when other attractions, such as concerts, moving pictures, and revues have been going on at the same time, large audiences have attended the science lectures, and have thus shown the existence of a real demand for more thoughtful recreation. The welfare work of the Y M.C.A. with the troops abroad is admirable in every respect, and the scheme of lectures now in operation merits all the assistance and encouragement which men of science can give it.

Although a few separate lectures are given to officers, most of them are delivered to the men, and officers are rarely present at them, though they are attracted by concert parties and like entertainments. It ought not to be supposed that the officers of our Army are less interested in scientific subjects than are the men of the rank and file, and their absence from lectures may be due to the fact that the Y.M.C.A. huts are regarded as places of recreation for the men only. As, however, Mr. McCowen, the chief secretary of the Y.M.C.A. in France, reports that the lecture scheme has succeeded almost beyond expectation, it would be worth while to develop the scheme still further by arranging more lectures for officers, not so much for purposes of instruction as to excite interest in scientific matters.

Of course, lectures on history, literature, the allied countries, and similar subjects have also been delivered, and, on the whole, historical subjects are probably the most popular. There is no doubt, however, that the science lectures have been a source of pleasure and enlightenment to thousands of our troops at the base camps and further up the line, and the Y.M.C.A. is performing a very useful service in organising them. The work is of such decided educational value that it should receive practical support from the State in the form of grants. With so large a part of our population serving with the forces at home and abroad, it should be possible for the Board of Education to make the Y.M.C.A. an education authority, and provide a substantial part of the funds required to carry on and extend the educational enterprise so successfully begun.

NANNA'S CAVE, ISLE OF CALDEY.

Caldey Island, in Carmarthen Bay, two miles south of Tenby, has been occupied since the prehistoric period, and, as is shown by the raised beaches in the vicinity, has been exposed to periodical eleva-

tion and depression. From time to time caves have been found in the Carboniferous limestone. Two of these were examined by a local clergyman about the middle of the last century, but the exploration was carried out in an unscientific way, and the remains discovered, without precise identification or record of stratification, are now deposited in the Tenby Museum. A more careful examination of the rock shelter, known as Nanna's Cave, has recently been made by local archæologists, and the results are described in a paper by Mr. A. L. Leach, reprinted from *Archaeologia Cambrensis* for July, 1916. Remains of two skeletons, one female, the other male, were found. The female skull presents no characters which enable us to separate it from modern British skulls, or from remains which have been found in Neolithic or later Palæolithic deposits. It may be as old as the Aurignacean; but it showed no character which would disprove it being of Neolithic or historic age. In association with it was found a skilfully struck flint flake, similar to that obtained from the Hoyle Cave near Tenby, which is probably of the late Palæolithic age. This fact, however, is not conclusive of the age of the human remains. In the Romano-British age the cave was again occupied, and some fragments of pottery of that period formed parts of an olla, or cooking-pot, and a mortarium, probably used for rubbing down fruits and other soft food.

POTASH FERTILISERS FROM FELSPARS.

THE dearth of potassium salts in this country owing to the war has caused renewed attention to be devoted to the possibilities of preparing soluble potassium salts from the large deposits of felspar which are found in certain parts of the country. The problem has occupied the attention of chemists intermittently for many years, but the processes devised in the past have proved commercially unsuccessful, owing largely to the failure to obtain, along with the potash salts, other saleable products which might share the cost of manufacture. This difficulty would appear to have been largely overcome in the process patented by Mr. J. Rhodin, a Swedish inventor, in which, along with the soluble potassium salts, a marketable white cement is obtained. The successful results obtained by this process with Swedish felspars have been brought to the notice of the Board of Agriculture and Fisheries, and under the auspices of a sub-committee of the Fertilisers Committee of the Board further tests with British felspars from Roche, in Cornwall, and Loch Eriboll, in Sutherlandshire, have been carried out, the results of which are summarised in the February issue of the *Journal of the Board of Agriculture*.

The Roche felspar, containing 10·8 per cent. K_2O, yielded 75 per cent. in a soluble form, whilst the Loch Eriboll spar, with 8·6 per cent. K_2O, gave 60 per cent. soluble. A Swedish spar, with 12·9 per cent. K_2O, yielded 54 per cent. in a soluble form. Expert opinion described the cement as a true hydraulic cement, of satisfactory colour, but of much lower tensile strength than Portland cement.

As the result of its examination, the sub-committee expresses the opinion that encouragement should be given to any movement for the manufacture of potash and white cement by the Rhodin process on a commercial scale, and that in the event of a public company applying to the Treasury for permission to raise capital to work this process, the application should receive the strong support of the Fertilisers Committee.

THE NATURAL SCIENCES IN PUBLIC SCHOOLS.[1]

Age Limits for School Science.

THE teaching of natural science in public schools is of recent growth. Until quite recently most of the boys who took up this subject did so with the intention of making use of the training in their future careers. Even now, in some public schools, the number of boys learning science is small. It is, however, becoming recognised that science should form part of every boy's general education. For this reason it is necessary to put some, at least, of a boy's general training in science before the age at which specialising should be allowed. Too early specialising is bad policy: the age at which this may be begun by the average boy is about sixteen and a half years.

Before this age (or its equivalent for forward or backward boys) the pupil should have spent, on an average, four hours a week at science for a period of at least two years, and six hours a week for a further two years. Thus the work should be begun in the preparatory schools. The only work recommended to be done there is in nature-study and practical measurements. See "Nature-Study in Preparatory Schools" and "The Correlation of Mathematical and Science Teaching" (Bell and Sons, each *6d.*).

After a boy has reached such a standard of general education that he may be allowed to specialise to a certain extent, he should have the opportunity of devoting about eight hours a week to science if he chooses to do so. At a still later stage the specialisation should be more marked in the case of those who choose a scientific career.

Science in Examinations.

If these ideals can be reached by any means other than making science compulsory in examinations, those means should be employed. If they cannot, compulsion by examination regulations must be applied. But this should then be recognised as a necessary evil. It is possible that some system of inspection of schools by examining bodies, combined with the granting of certificates on the recommendation of a properly qualified master, might prove to be the solution of the difficult problem of insisting on science being learnt by every boy, without the restrictions necessarily imposed when there are examination syllabuses. But the details of such a scheme would require careful thinking out.

But there is, at present, a yet stronger argument against the attempt to foster the teaching of science by making the subject compulsory in examinations. So long as instruction in science was given only to those who were destined for a scientific career, it was natural (if, perhaps, unwise) to aim chiefly at inculcating scientific method, with a certain disregard of general knowledge of natural phenomena. This was done, for the most part, by logical courses in hydrostatics, heat, light, electricity, and chemistry. But in some of the schools where science has already become a compulsory subject it has been recognised that such courses may be unsuitable for the non-scientific mind. The attempt is made to arouse a boy's appreciation of the value and scope of science rather than to teach him the elements of a subject which he will drop even before leaving school. In such schools a considerable proportion of his science hours is devoted to studying subjects ranging from the universe to the electron: astronomy, geology, biology, physio-

[1] Abridged from a memorandum drawn up by the committee of the Association of Public School Science Masters to serve as the text of the evidence offered on behalf of the association to the Government Committee on the Teaching of Science.

logy, etc., are all drawn upon in such teaching; and science is taught in a general manner by directing the attention of pupils towards objects rather than by making them learn "subjects." In other schools the study of science is *approached* through its applications in engineering or agriculture.

Now that science is becoming recognised as an essential part of a liberal education, it is probable that the kind of teaching indicated above will be more generally adopted. The inevitable effect of making science compulsory in examinations would be to hinder experimenting in educational methods, at a time when this is most important.

Examination for Entrance to Public Schools.

The work recommended to be done in the preparatory schools is not systematic science, but rather a preparation for this. The kind of nature-study and observational work adopted in the various schools should differ according to their locality and other circumstances. This makes the subject a difficult one for examination purposes, and anything of the nature of a rigid syllabus would have a deadening influence. But so important is this preliminary work that unless preparatory schools will adopt it without compulsion through examinations, the subject should form an essential part of the Common Entrance Examination. The questions set should cover a wide range and offer plenty of choice to the candidate.

It is of the utmost importance that every candidate for scholarships on entering a public school should be examined in such work, and that a high proportion of the total marks should reward him for good work in this subject. The reason for this is obvious. So long as science forms no part of the examination for scholarships, the cleverer boys at the preparatory schools will be tempted to neglect the subject, even when provision is made for teaching it, in order to *specialise* in more paying subjects. Having found these subjects pay, and having attained a certain proficiency in them, they are unlikely to wish to change to science, or to be allowed to do so if they wish. Thus the most clever boys are diverted from science quite early in their lives; it is not putting it too strongly to say that in the large majority of public schools only those boys who show no signs of becoming scholars in other subjects can take up science seriously. We see here the evils of early specialising in their most pronounced form.

Entrance Examinations to Universities and Equivalent School Certificate Examinations.

Compulsory Greek *must* be abolished. Science should take at least as important a place as Latin.

One of the worst things that can be done in these examinations is to group science with mathematics (as is suggested in recent Board of Education circulars and in the reports of the Previous Examination Syndicate). That means filling the upper science divisions of the schools with boys who are weak at mathematics, merely because of that weakness.

Entrance Scholarships offered by the Universities.

The work of schools is affected greatly by these examinations. In their present form these encourage boys to specialise too early. This statement applies to all the subjects of examination. There is little doubt that at present scholarship examinations are exerting a bad influence on general education.

With regard to science in particular, the examinations often have the effect of making boys specialise too strictly within the limits of the subject itself, to the detriment of their general training in science. If a boy knows, for instance, that he may get a scholarship in chemistry alone, he is tempted to neglect the study of kindred subjects. Scholarship papers should test the candidates' general knowledge of science more thoroughly than they do at present.

Fees.

Laboratory work is expensive. It is customary to make special charges for this. In schools where science is compulsory for all boys, the charges do not keep the boys from doing some science; but in some schools where science is not compulsory the charges do have this effect. In certain instances the charges are grossly unfair (in view of the small expenditure on laboratory equipment), and the boys who learn science are robbed in order to provide cheap education for those who do none.

Organisation.

In nearly every school the rate of a boy's progress through the various forms is controlled to an unfair extent by his proficiency in classical subjects. This might be improved by giving a better range of marks for science, but the real remedy is that boys should be grouped for science and mathematics separately from form subjects. Otherwise the logical sequence necessary for science must be broken.

The Teaching of Mechanics.

This is in a most unsatisfactory position. The subject is fundamental for a right study of science. But, as a rule, it is in the hands of mathematicians, who too often do no experimental teaching and treat the subject deductively. Laboratory work in mechanics is essential.

Laboratory Equipment.

During the past twenty years great improvement has been made with regard to equipment for science teaching. Laboratories for the teaching of practical mathematics, including mechanics, are now the most general need.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. D. Keilin, of Magdalene College, has, with the consent of the Vice-Chancellor, been appointed assistant to the Quick professor of biology.

The next combined examination for entrance scholarships and exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

LONDON.—The following doctorates were conferred by the Senate at the meeting held on March 21:—*D.Sc. in Chemistry:* Mr. Frank Tinker, an external student, for a thesis entitled "The Colloidal Membrane: its Properties and its Function in the Osmotic System," and other papers. *D.Sc.* (*Engineering*) *in Metallurgy:* Mr. Andrew McCance, an internal student of the Imperial College (Royal School of Mines) and the South-Western Polytechnic Institute, for a thesis entitled "A Contribution to the Theory of Hardening." *D.Sc.* (*Economics*): Mr. J. F. Burke, an internal student of the London School of Economics, for a thesis entitled "The Reform of Irish Land Tenures."

The Carpenter medal for the period 1913–16 has been awarded to Dr. P. B. Ballard for the thesis

entitled "Obliviscence and Reminiscence," for which he obtained the degree of D.Lit. in 1914.

The annual report on the work of University College has just been issued. The total number of students on the college books for the academic year 1915–16 was 1133 (including 51 refugee students), whereas the normal number is about 2200. Of the 1133 there were 535 men (including 36 refugee students); of the 535 men, only 222 were in attendance throughout the session, the remainder taking up military or naval service or some special form of war-work. The normal fee revenue is upwards of 29,000*l.*; the fee revenue for 1915–16 was 14,983*l.* By means of drastic economies and postponement of expenditure, and with the help of generous donations from members and friends of the college, supplemented by the special Treasury grant, expenditure was kept within income. The financial outlook for the current session (1916–17) causes anxiety, the fee revenue having further declined. The chairman and the acting treasurer are asking for help to meet the threatened deficiency, and also to cover the expenditure on the new chemistry buildings that has not yet been provided; this amounts to 15,000*l.* The third issue of the *Pro Patria* list, with the supplement recently prepared, contains 1554 names of members of the college, 1516 of whom are on active service. Of these, 122 have fallen in the war.

OXFORD.—The Departments of Geography and Anthropology have published their arrangements for next term. In geography, lectures will be given on map projections, the historical geography of Europe, the West Indies, and British lands round the Indian Ocean. Practical classes, field work, and informal instruction are also announced. The list of lectures in anthropology includes human anatomy, ethnology, the distribution of man, comparative technology, stages of human culture, the Bronze and early Iron ages, and questions relating to ancient Egypt. Lectures and informal instruction are also announced on various topics of social anthropology and on primitive language in its relation to thought

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THE presidential address delivered by Prof. A. N. Whitehead to the Mathematical Society last January is printed in the current issue of the *Technical Journal*. The subject of the address was the relation of technical education to science and literature, and Prof. Whitehead's ideas deserve wide and careful consideration. The immediate need of the nation, he maintains, is a large supply of skilled workmen, of men with inventive genius, and of employers alert in the development of new ideas; and there is only one way to obtain these, namely, by producing workmen, men of science, and employers who enjoy their work. The basis of the growth of modern invention is science, and science is almost wholly the outgrowth of pleasurable intellectual curiosity. A technical education which is to have any chance of satisfying the practical needs of the nation must be conceived in a liberal spirit as a real intellectual enlightenment as to principles applied and services rendered. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart both technique and intellectual vision. In any system of technical education, training should be broader than the ultimate specialisation, for the resulting power of adaptation to varying demands is advantageous to the workers, to the employers, and to the nation. Prof. Whitehead applies his generalisations to the specific cases of pupils of thirteen who have completed their elementary education, and those of seventeen whose technical education, so far as it is compressed within a school curriculum, is ended.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 15.—Sir J. J. Thomson, president, in the chair.—Prof. T. H. **Havelock**: The initial wave-resistance of a moving surface pressure. Hitherto the wave-resistance associated with the motion of an assigned pressure system over the surface of water has been studied only in the steady state for uniform motion. The present work is an attempt to calculate this quantity at any time for a system which has been suddenly established and set in uniform motion at a certain instant.—Prof. S. W. J. **Smith** and H. **Moss**: Experiments with mercury jets. (i) The relation between the jet-length and the velocity of efflux. (ii) A comparison with jets of other liquids. It has probably been noticed by those who have worked with mercury "dropping electrodes"—in which the mercury issues in a narrow stream from the drawn-out end of a vertical tube—that the length of the jet alters in a peculiar way with the length of the mercury column producing it. The results of a study of this phenomenon are given.—Prof. W. H. **Young**: The mode of approach to zero of the coefficients of a Fourier series.—R. O. **Street**: The dissipation of energy in the tides in connection with the acceleration of the moon's mean motion. On the hypothesis of non-turbulent motion harmonic with respect to the time with a period of twelve hours, an expression is obtained for the mean rate of dissipation of energy by viscosity in a portion of the ocean in the form of a surface integral over that area of a function of the surface current-velocities only. This integral has been evaluated over the greater part of the Irish Sea, the mean rate of dissipation obtained being 5×10^9 foot-poundals per second. In the absence of external forces, this rate of dissipation would cause the energy to be reduced in the ratio *e* to 1 in about two hours. If the rate of dissipation per unit area for the whole ocean were the same as in the Irish Sea, the total frictional loss of energy by the tides would be at the mean rate 6×10^{13} foot-poundals per second. If the apparent lunar acceleration is attributed to a slowing of the earth's axial rotation, a retardation of the order four minutes of arc per century per century is necessary for its explanation. This retardation implies a decay of the earth's kinetic energy of rotation at the rate of 1.6×10^{13} foot-poundals per second, which is about a quarter the mean rate of dissipation of tidal energy on the above hypothesis. A maximum surface current velocity of 2 ft. per second over the whole ocean would give rise to sufficient dissipation to account for this retardation of the earth.

Optical Society, March 8.—C. L. **Redding**: A simple method of determining the size of the tool required for a given block of lenses. When a new system of lenses has to be worked, it is desirable to select the best method of blocking, and to make the diameter of the tool equal to the diameter of the complete block. The size of the tool may be determined by calculation or by previous experience, but the author described how this may also be done by making use of any concave tool of known radius.—T. F. **Connolly**: A variable angle collimator. The instrument described differs from an ordinary collimator in having a bi-prism introduced between the diaphragm and the object-glass. The effect of this is to produce two separate images of the central wire, which images are collimated by the object-glass as though they were real wires. The bi-prism is mounted in a short tube sliding within the collimator body, and its position is indicated on the outside of the collimator on a longitudinal scale. A movement of the bi-prism

varies the distance between the images as it slides along, and this variable separation of the collimated images provides a convenient means for angular measurement. If the scale is graduated to correspond with angular separation, it can be used as a standard of angular measurement for such purposes as marking off or checking stadia intervals on levels or theodolites, or for checking the graticules in prism binoculars.—P. F. **Everitt**: The design and testing of telescope objectives. The author first described the four principal aberrations of the telescope objective, proceeding from them to others of less importance, and finally reducing the problem to the fulfilment of three or more of six conditions which it is desirable to satisfy. After referring to the existing tables of approximate solutions, trigonometrical formulæ are given by means of which selected rays are accurately traced through an objective, and the aberration is shown numerically in an example in which the chromatic aberration of an objective is altered at will. A short description of the main types of objectives was given, showing the purposes for which they are best adapted, and also some methods of testing, including the Hartmann system.

Physical Society, March 9.—Prof. C. V. Boys, president, in the chair.—Dr. P. E. **Shaw**: To measure the pressure in a high vacuum by observations of logarithmic decrement. In experiments on the Newtonian constant (*Phil. Trans.*, May, 1916) the author used a torsion balance in a vacuum which varied in different cases from 15 mm. to 0·00001 mm. pressure. Before sealing the vessel the pressure was determined by a McLeod gauge. Values of the pressure after sealing off were deduced, in the case of the higher vacua, from observations of the damping of the torsion system. The formula employed is due to the late Prof. Poynting, and can be expressed in the form

$$P = 35{\cdot}6 \frac{I}{saT}\lambda,$$

where I=moment of inertia of suspended system, s=area of surface (supposed plane) which is experiencing the resistance, a=mean distance of plane from centre of rotation, T=period of oscillation, and λ=the observed logarithmic decrement. A table and curve are given showing the relation between P and λ.—A. W. **Clayden**: A diffraction colour box. The apparatus consists essentially of a very simple concave grating spectroscope, of which the slit and grating are situated at opposite diameters of a circle, the spectrum being formed on the arc of this circle. Two independent arms carry fittings on which may be placed either telescope eyepieces or small electric lamps. With the slit of the instrument illuminated by a suitable source, the eyepieces can be set so that any two desired wave-lengths are in the centres of their respective fields of view. The eyepieces are then replaced by the small lamps (the filaments coinciding with the previous positions of the cross-lines), and the grating is observed with a small telescope pointed towards the widened slit; the whole of its surface is seen to be illuminated with a mixture of the two colours on which the eyepieces were originally set. The "concave grating" employed consists of a Thorpe replica of a Rowland plane grating of 14,475 lines to the inch, mounted with its ruled surface in contact with the surface of a concave mirror of 4-ft. focal length. This forms an admirable substitute for the more expensive concave grating. The author prefers to state results in terms of the number of oscillations per unit of time. Observations showed that the smallest change of wave-length which could be recognised by the eye as a change of colour was greater than that which corresponded to a change of period of 10^{-8} vibrations per second, or to a change of one vibration more or less in $1/10^{-8}$ second.—Prof. W. M. **Coleman**: An apparatus for studying the effect of Hertzian waves on the heart. A simple pendulum, consisting of a cylindrical brass bob terminating in a pointed wire coaxial with the bob, hangs by a piece of string above one of the terminals of an induction coil, so that in its lowest position the point of the bob is within sparking distance of the terminal and vertically above it. The bob is connected by a piece of flexible wire to the other terminal of the coil. When the pendulum is set oscillating there is a shower of sparks every time the bob passes its lowest position. The frequency of intermittence can be varied by altering the length of the suspension. By adjusting the period of the pendulum nearly to the time of a heart-beat any possible effect on the rate of the beating may be observed. The condensed discharge from two Leyden jars is employed.

Geological Society, March 14.—Dr. A. Smith Woodward, vice-president, in the chair.—L. M. **Parsons**: The Carboniferous limestone bordering the Leicestershire coalfield. The inliers of Carboniferous limestone situated along the northern border of the Leicestershire coalfield crop out in two well-defined series: a western series composed of almost horizontal beds exposed by stream-erosion, and an eastern series in which the limestone is highly inclined and complicated by faulting. The thinly bedded limestones, shales, and dolomites of the western inliers are of a slightly higher horizon than that of the uppermost beds of the more massive dolomites seen at Breedon and Breedon Cloud farther eastwards. In no part of the district is the base of the Carboniferous seen, although borings have shown that the limestone rests upon pre-Cambrian rocks in the neighbourhood of Charnwood Forest.

Linnean Society, March 15.—Sir David Prain, president, in the chair.—C. E. **Jones**: Methods of preparing plants for exhibition. The experiments described have been carried out in connection with the exhibition of plants in the Department of Botany, Natural History Museum, South Kensington, where specimens of the results can be seen (see also NATURE, November 9, 1916, p. 191).—Dr. R. R. **Gates**: A systematic study of the North American Melanthaceæ from the genetic standpoint. The author's point of view is the assumption, based upon experiment during the last fifteen years, that the variations which mark species have not been universally continuous and infinitesimal, but often definite and discontinuous. Definite variation is not necessarily orthogenetic variation, but marked variation which may occur in any, or in many, directions simultaneously. The experience gained in work on the mutations in Œnothera are turned to account in this group of Liliales which has not hitherto been the subject of experiment. Pairs of species have been taken and investigated on this basis. Related genera showing marked differences in structure often co-exist side by side, showing that these differences cannot be claimed as of selective value, but have arisen from "spontaneous variation" and have been perpetuated by heredity.

Mineralogical Society, March 20.—Mr. W. Barlow, president, in the chair.—A. **Holmes** and Dr. H. F. **Harwood**: The basaltic rocks of Spitsbergen and Franz-Joseph Land, with conclusions regarding the Brito-Arctic Tertiary Petrographic Province. These rocks, which were obtained respectively from Prof. Garwood and the Geological Survey of England and Wales, are very similar not only to the basaltic rocks previously described from neighbouring localities, but

also to the basalts of the whole Arctic region stretching from Dickson Harbour to West Greenland. The essential minerals are labradorite, rich in the anorthite molecule, pyroxene of the enstatite-augite type, and titaniferous magnetite. The province as a whole displays significant variations both in time and space. The earliest eruptions are generally poor in alkalies, but tend to become more alkaline as the present period is approached. Thus, the later eruptions of Spitsbergen gave rise to olivine trachydiorites instead of basalt. Jan Mayen still possesses an active volcano, and its rocks are unusually alkaline basalts. Similarly, the later rocks of Iceland and, to a lesser extent, of Skye and the Small Isles follow the same course. In space the most remarkable variation is seen in the distribution of titanium, the percentages of titanium oxide being high in the rocks of Greenland and the Iceland Ridge, and falling away regularly on each side. The Brito-Arctic Petrographic Province can be subdivided into five regions, viz. the British, the Icelandic (including the Faroe Islands and the Scoresby Sound district), the West Greenland, the Jan Mayen, and the Spitsbergen—Franz-Joseph Land—Dickson Harbour, and the differences subsisting between them are related to the processes whereby the igneous activity was initiated. It is suggested that a petrographic province consists of a number of adjacent regions of igneous activity, in which similar rocks, or similar series of rocks, have been produced, whence it follows that the processes by which the magmas have been formed, differentiated, and intruded must be similar, and the underlying materials on which these processes have acted must also be similar.—Dr. J. W. **Evans**: A general proof of the limitation of the symmetry-numbers of crystals. On the assumption that crystals are composed of cells identical in all respects, then, if n be the degree of the symmetry of an axis and d an integer, the equation

$$\cos \frac{2\pi}{n} = \tfrac{1}{2}(1-d)$$

must be satisfied. The only possible values of d are 3, 2, 1, 0, the corresponding values of n being 2, 3, 4, 6.—E. S. **Fedorov**: The numerical relation between zones and faces of a polyhedron. The numerical relation shown by axes of symmetry situated in planes of symmetry pointed out by G. Cesàro in 1015 is only a particular case of the more general one deduced by the author in 1885.—A. **Ledoux**, T. L. **Walker**, and A. C. **Wheatley**: The crystallisation of parahopeite. Crystals in the Royal Ontario Museum of Mineralogy from the original locality, Broken Hill, North-Western Rhodesia, are triclinic with the axial ratios $a:b:c=0{\cdot}7729:1:0{\cdot}7124$; $\alpha=93^\circ\ 22'$, $\beta=91^\circ\ 12'$, $\gamma=91^\circ\ 22'$. Thirty-two forms are recorded. The crystals have perfect cleavage parallel to the brachypinacoid, and show lamellar twinning parallel to the macropinacoid. The angle of optical extinction on the cleavage is 10° with reference to the twin-lamellæ.

Royal Meteorological Society, March 21.—Major H. G. Lyons, president, in the chair.—Major G. I. **Taylor**: The formation of fog and mist. Fogs are due either to precipitation of water in the air or to a condition of the atmosphere which prevents smoke from being dispersed from the air close over the roofs of a town. The two necessary conditions for the formation of a smoke fog are that the wind velocity must be very small and the air near the ground must be relatively cold compared with the air higher up for a period sufficiently long to collect enough smoke to form a fog. The formation of fog at sea can usually be traced to the cooling of the surface air when it flows from a place where the sea is warm to a place where it is cold, but sometimes a fog is caused by air flowing from a cold to a warm part of the sea. In the former case the fogs are usually low-lying and thick, while in the latter they are more frequently light fogs which stretch up to a considerable height. Fogs consisting of small drops of water are formed on land, too, by the cooling of surface air, but in this case the air usually stays still, while the lowering of the temperature of the ground by radiation to the sky at night cools the air near the surface. Fogs of this type are not formed until the temperature has fallen considerably below the dew-point of the air during the day. This is because the formation of dew dries the air near the ground. Theoretical considerations show that the amount by which the temperature must fall below the dew-point before fog is produced depends on a complicated series of causes, but an empirical method has been devised for estimating whether, on any given night, there is enough water vapour in the air to form a fog if other conditions are suitable. This method can be used for local forecasting.

CAMBRIDGE.

Philosophical Society, February 19.—Dr. Marr, president, in the chair.—B. **Sahni**: 1. An Australian specimen of *Clepsydropsis*. 2. Observations on the evolution of branching in ferns. The evolution of the branching of the fern stem is discussed for the first time from the point of view of vascular anatomy. It is concluded that dichotomous branching is primitive and that monopodial branching is derived from it by the successive intercalation, at the base, of a series of stages, each morphologically less complex than the preceding. The process has thus been one of retrogressive evolution in the basipetal direction.—C. P. **Dutt**: Some anatomical characters of coniferous wood and their value in classification. The author directs attention to the confusion in existing accounts of the pitting associated with medullary ray cells and gives the result of an investigation on the same subject. Conclusions are drawn as to the value of such pitting as a diagnostic character.

MANCHESTER.

Literary and Philosophical Society, February 20.—Prof. S. J. Hickson, president, in the chair.—Dr. W. **Makower**: The photographic action of α rays. The first important investigation of the photographic action of α particles was made in 1910 by Kinoshita, who succeeded in showing that whenever an α particle strikes a grain of silver haloid in a photographic plate, that grain is afterwards capable of photographic development; moreover, this was true throughout the range of the α particle. Later it was shown by Reinganum and others that when α particles are projected tangentially to a photographic plate, after development the film shows definite trails of grains of silver halide, which can readily be distinguished under the microscope. These trails are produced by the impact of the α particles on the haloid grains as they pass through the film, and their length represents the range of the α particles in the film of gelatine. Photomicrographs showing the paths of α particles through photographic films were first published by Walmsley and Makower, and soon afterwards by Kinoshita and Ikeuti. The method adopted by the latter was to activate the tip of a sewing-needle by gently rubbing it on a surface coated with the active deposit of radium or some other source of α radiation. In this way a trace of active matter was transferred to the point of the needle, which was then placed for a short time in contact with a photographic film. The grains affected by the α particles can be clearly seen radiating out in straight lines from centres representing the points at which the needle had been brought into contact with the films.

EDINBURGH.

Royal Society, February 5.—Dr. Horne, F.R.S., president, in the chair.—Prof. A. A. **Lawson**: The gametophytes of the Psilotaceæ. This paper was a continuation of previous work, filling in a number of details, especially with regard to the sexual organs. The most important fact was the establishment of the structure of the protruding neck of the Archegonium, differing from that of other Pteridophytes in being evanescent. After fertilisation it falls away, leaving the basal tier of cells, which are persistent and were at first held to represent the whole neck. Important researches in the embryology will form the subject of a later paper.—J. McLean **Thompson**: The anatomy and affinity of *Stromatopteris moniliformis*, Mett. This curiously specialised fern is from the arid commons of New Caledonia. It shows many signs of reduction, and is specialised for a xerophytic existence. The construction of the stem indicated a Gleicheniacean affinity, and the form and construction of the spore-producing members confirmed this relationship. But the special form and peculiar appendages seemed to confer an individuality on the plant which could not be overlooked, and the opinion was expressed that Stromatopteris was a distinct and monotypic genus closely allied to Gleichenia.—Prof. and Mrs. A. D. **Ross**: Preliminary note on the peculiarities of the tides round Western Australia. Among the peculiarities mentioned was the frequent occurrence of daily tides instead of half-daily; a sufficient explanation was given in terms of the moon's declination. The whole subject demanded a careful investigation, which the authors were now entering on.

February 19.—Sir E. A. Schafer, vice-president, in the chair.—Dr. J. **Horne** and Dr. B. N. **Peach**: The bone cave in the valley of the Allt nan Uamh (Burn of the Caves), near Inchnadamff, Assynt, Sutherlandshire; with notes on the bones by E. T. Newton. The bone-cave, which is situated on the north side of the valley, was evidently initiated at a certain stage in the history of the Glacial period, after the deposition of some ground moraine in the valley. It yielded a series of deposits, some of which are of exceptional interest. The oldest date back to a late stage in the glaciation of the region, and point to a partial erosion of the drift during a recession of the ice. Two of the six layers in the cave, viz. the third and fifth in descending order, have furnished the remains of a northern lynx, the Arctic lemming, the northern vole, the brown bear, reindeer, red deer, and other mammals, with the bones of a number of birds, those of ptarmigan occurring in profusion. The lynx, lemming, and northern vole give a boreal aspect to the fauna. In the south of England these mammals are regarded as Pleistocene forms. Between the third and fifth layers occurs a layer of compact grey clay, with quartzite stones, which have been transported from the high ground to the east (Breabag). This material is regarded as of morainic origin, produced during a re-advance of the local glaciers. In the upper mammaliferous deposit, which is a genuine cave earth, or *terra rossa*, there is evidence, at various levels, of human occupation in the form of layers of charcoal and split and burned bones. No artifacts were recorded. Overlying the cave earth there is a lenticular bed of shell marl, composed of the remains of land shells.—A. M. **Williams**: The adsorption of sulphur dioxide by charcoal at -10° C. The aim of the research was to find out how the heat evolved on the adsorption of a vapour varied with the amount adsorbed. Measurements were taken of the amount adsorbed, the pressure, and the isothermal heat of adsorption at constant volume. The adsorption isotherm was a typical adsorption curve, similar to that found by Trouton for the adsorption of water vapour. The heat of adsorption curve passed through a minimum and a maximum and, finally, ran parallel to the adsorption axis. A tentative explanation was offered.

PARIS.

Academy of Sciences, February 12.—M. A. d'Arsonval in the chair.—G. **Lippmann**: Some decisions taken by the Governments of Great Britain and the United States. An account of the Government measures for utilising scientific methods for increasing the national security and prosperity. An account is given of the constitution of the Imperial Trust and Advisory Council, the scope of its work, and the funds at its disposal. In the United States the National Research Council, nominated by the Washington Academy of Sciences, is working on the same lines.—G. A. **Boulenger**: The nuptial tubercles simulating teeth in an African fish of the genus Barbus.—M. **Balland**: Soya as a French foodstuff. The soya bean contains 40 per cent. of nitrogenous material and 20 per cent. of fat, as against 20 per cent. of nitrogenous material and 2 per cent. of fat in French haricots. Soya has already been successfully employed as a foodstuff in France, and analyses of this and other foreign leguminous foodstuffs are given.—M. **Mesnager**: A simple solution of Mathieu's problem A.—A. **Ledoux**: New method for the determination of the refractive index of liquid substances.—MM. **Massol** and **Faucon**: Absorption of the ultra-violet radiations by some chlorine derivatives of ethane, ethylene, and acetylene. No absorption bands were given by hexachloroethane and tetrachloroethane. With tetrachloroethylene in 1 mm. layer all radiations starting with $\lambda=271$ are absorbed. Acetylene in acetone or acetone-alcohol solution shows a considerable absorption, but no bands.—J. **Bougault**: Mixed anhydrides derived from benzoylacrylic acid Some new examples of a reaction previously described, together with a discussion of the mechanism of the reaction.—V. **Commont**: The tufas of the valley of the Somme: Neolithic and prehistoric tufas, and tufa of the historic period. The tufas of the Somme valley were formed at various times in the Neolithic, protohistoric, and Gallic periods. The peat and tufa were formed simultaneously. The marine shells found are the *débris* of Gallo-Roman cooking.—M. **Russo**: Geological observations on the Tadla synclinal (western Morocco). —L. **Daniel**: The influence of grafting upon the adaptation products of the cactus. A morphological examination alone is insufficient for drawing definite conclusions as to the integral conservation of the characters peculiar to the grafted plants, since microchemical analysis of their tissues may reveal changes which, without it, would escape the notice of even a practised observer.

February 19.—M. A d'Arsonval in the chair.—The president announced the death of M. Bazin.—G. **Bigourdan**: Some observatories of the northern part of France in the seventeenth century. Details are given of work done at Blois and Caen.—M. **Fournier**: A problem in the design of the hull of a ship.—C. **Camichel**: The calculation of large extra pressures in water-mains furnished with an air reservoir.—Ch. J. **Gravier**: The association of a siliceous sponge, of a sea-anemone, and an annelid in the depths of the Atlantic.

PETROGRAD.

Imperial Academy of Sciences, Physico-Mathematical Section, November 16.—A. A. **Bèlopolskij**: Researches on the spectrum of the variable γ Boötis.—V. **Chlopin**: Boron and its occurrence in Russia.—E. **Eremina**: Fluorspar in Russia.—I. **Ginsburg**: Mica, its properties, uses, and occurrence in Russia.—G. Ju. **Vereščagin**: Report on the work carried out at Lake Baikal in the summer of 1916.—N. F. **Kaščenko** and

M. P. **Akimov**: *Rhinolophus bocharicus*, n.sp.—M. D. **Zalesskij**: A marine sapropelite of the Silurian period formed by a cyanophycean alga.

December 3.—A. A. **Bělopolskij**: Researches on the spectrum of δ Cassiopeiæ.—A. M. **Liapunov**: A formula of analysis.—P. **Krylov** and E. **Šteinberg**: Contributions to the flora of the Kansk district, province of Jenissei.—E. **Eremina**: Genesis of fluorspar in Russia.—M. A. **Rakuzin**: Absorption in petroliferous strata.—H. **Baklund**: Fall of a meteorite at Boguslavka, neighbourhood of Vladivostok.—N. V. **Nasonov**: The Turbellaria fauna of Finland.—V. I. **Bianchi**: (1) The birds of the Government of Tver. (2) Our present knowledge of the avifauna of the Government of Olonetz. (3) Geographical distribution of birds in North-West Russia-in-Europe. (4) Synoptic table for determining the Chiroptera of Russia-in-Europe. (5) The nidification of the birds of the Government of Petrograd. (6) Preliminary notes on Russian Chiroptera.—G. B. **Florovskij**: The mechanism of reflex salivary secretion.—N. S. **Kurnakov** and S. F. **Žemčužnij**: The magnesium salt lakes of the Perekop group.

HISTORICO-PHILOLOGICAL SECTION, November 29.—S. F. **Oldenburg**: Short description of a small collection of Khotan antiquities belonging to D. V. Kossikovskij.

December 7.—V. M. **Ionov**: The study of the pre-Christian faith of the Yakuts.—K. A. **Inostrancev**: A few remarks on the religion of the ancient Turks.—A. A. **Šachmatov**: Note on the language of the ancient Bulgars.—F. I. **Ščerbatskoj**: The doctrine of the categorical imperative among the Brahmans.—A. D. **Rudnev**: Cha-Ošir. Translation of a fragment of a Buriat epic.

BOOKS RECEIVED.

The Idea of God in the Light of Recent Philosophy. By Prof. A. Seth Pringle-Pattison. Pp. xvi+423. (Oxford: At the Clarendon Press.) 12*s.* 6*d.* net.

The Combination of Observations. By D. Brunt. Pp. x+219. (Cambridge: At the University Press.) 8*s.* net.

The Psychology of Sound. By Dr. H. J. Watt. Pp. vii+241. (Cambridge: At the University Press.) 10*s.* 6*d.* net.

Domestic Economy: a Text-book for Teachers and Students in Training. New edition. Part i., Theory. By M. G. Bidder. Pp. vi+167. Part ii., The Practice and Teaching of Domestic Economy. By F. Baddeley. Pp. vi+189. (Cambridge: At the University Press.) 2*s.* 6*d.* net each.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1917. Pp. 779. (London: H. Greenwood and Co., Ltd.) 1*s.* net.

British Museum (Natural History). Report on Cetacea Stranded on the British Coasts during 1916. By Dr. S. F. Harmer. (London: British Museum (Natural History); Longmans and Co., and others.) 1*s.* 6*d.*

Year-book of the Royal Society of London, 1917. Pp. 235. (London: Harrison and Sons.) 5*s.*

The Order of Nature. By L. J. Henderson. Pp. v+234. (Cambridge, Mass.: Harvard University Press; London: H. Milford, Oxford University Press.) 6*s.* 6*d.* net.

The Banket: a Study of the Auriferous Conglomerates of the Witwatersrand and the Associated Rocks. By Prof. R. B. Young. Pp. xv+125+plates xxviii. (London: Gurney and Jackson.) 8*s.* 6*d.* net.

The Calculation and Measurement of Inductance and Capacity. By W. H. Nottage. Pp. 137. (London: The Wireless Press, Ltd.) 2*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, MARCH 29.

ROYAL SOCIETY, at 4.30.—The Fourth Colourless Sensation in the Spectrum Sensation Curve when Measured in the Centre of the Retina: Sir William Abney.—Magnetic Inertia: G. W. Walker.—The Selective Properties of the Copper-ferrocyanide Membrane: F. Tinker.—X-Ray Analysis of the Crystal-structure of Rutile and Cassiterite: C. M. Williams.—Discontinuous Fluid Motion: Dr. J. G. Leathem.

ROYAL INSTITUTION, at 3.—Telephony: Prof. J. A. Fleming.

AERONAUTICAL INSTITUTE, at 8.—The Necessity for New and Special Treatment of Metals Employed in Aircraft Construction: J. de Kozlowski.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Further Experiments upon Wake and Thrust Deduction Problems: W. J. Luke.—Some Experiments on the Influence of Running Balance of Propellers on the Vibration of Ships: J. J. King-Salter.—Theory of Wave Motion on Water: Sir George Greenhill. At 3 p.m.—Marine Application of Reduction Gears of Floating Frame Type: J. H. Macalpine.—Launching: P. A. Hillhouse and W. H. Riddlesworth.—Buoyancy and Stability of Submarines: Prof. W. Hovgaard.

LINNEAN SOCIETY, at 5.—Prof. T. H. Morgan's Work on the Mechanism of Heredity: W. Bateson.

FRIDAY, MARCH 30.

ROYAL INSTITUTION, at 5.30.—Recent Developments of Molecular Physics: Prof. J. H. Jeans.

GEOLOGISTS' ASSOCIATION, at 7.30.—Cephalopoda, and their Value in Geological Study: W. F. Gwinnell.

SATURDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

MONDAY, APRIL 2.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Two Journeys in the High Atlas: Capt. A. J. A. Douglas.

ARISTOTELIAN SOCIETY, at 8.—Is There any Justification for the Conception of Ultimate Value? W. A. Pickard-Cambridge.

TUESDAY, APRIL 3.

RÖNTGEN SOCIETY, at 8.15.

ZOOLOGICAL SOCIETY, at 5.30.—Big-Game Shooting in India: A. Ezra.—Notes on some of the Viscera of an Okapi, *Okapia johnstoni*: R. H. Burne.

WEDNESDAY, APRIL 4.

ENTOMOLOGICAL SOCIETY, at 8.

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THURSDAY, APRIL 5, 1917.

THE TEACHING OF PHYSIOLOGY.

(1) *Human Physiology: a Text-book for High Schools and Colleges.* By P. G. Stiles. Pp. 405. (Philadelphia and London: W. B. Saunders Co., 1916.) Price 6*s.* 6*d.* net.

(2) *The Problems of Physiological and Pathological Chemistry of Metabolism for Students, Physicians, Biologists, and Chemists.* By Dr. Otto von Fürth. Authorised translation by Prof. Allen J. Smith. Pp. xv+667. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 25*s.* net.

(1) AT the January Conference of Headmasters a resolution was passed recommending the teaching of the "natural laws underlying the phenomena of daily life." A similar resolution was passed at a meeting of the Association of Science Teachers, in which the value of exciting a "spirit of interest and inquiry with regard to the world around us and the universe at large" was emphasised (see NATURE of February 1, p. 442). It was thought that the best way of doing this was by courses of generalised science. It was doubtless not intended to exclude knowledge of the activities of living organisms, inclusive of man, and of our own bodily functions. In other words, physiology should be part of the course. We may remember Huxley's advocacy of physiology as of especial value as a means of mental discipline, and it has also an important practical side. The ignorance of most people with regard to questions of vital consequence is scarcely less than scandalous, and it is unfortunate that there appears to be a widespread belief that physiology is only of use to the medical man. Of course, it is necessary to him in order that he may understand the abnormalities of disease; but a knowledge of the normal working of our bodies is surely a matter that concerns everyone. The pressing question of food is one that presents itself at once, and there are many others.

The book before us is an excellent attempt to provide a text-book for high schools. But, good as it is as an elementary account of the present state of physiological science, it cannot be regarded as altogether successful. It is apt to be dull and didactic rather than stimulating. This is probably incidental to the practice, intentionally adopted, of omitting reference to names of discoverers and details of experimental procedure. In the hands of a good teacher such details may be made to give a human interest to dry description, and bring what is being taught into relationship with other bodies of knowledge, such as history and art, a valuable aspect of true education. It would be an improvement if a part of the wealth of the book in facts were sacrificed for a more intensive treatment of some of them. In certain cases further space could be found by omitting reference to views that are now disproved. Similarly, a rather more dogmatic tone might be used in many instances. A text-book should take the responsibility of recommending a particular view as being most in accordance with facts, although this view may be contrary to the opinion of some isolated physiologists.

It will be agreed that the mode of teaching of science suggested in the resolutions given above depends for its success almost entirely upon the teacher. A very wide knowledge is required, not only of science, but of other branches of learning, and it may well be that a special training is advisable. Indeed, the capacity necessary is probably of a higher order than that of many a university professor. It need scarcely be said that the right kind of teacher must be able to demand a high salary.

We cannot help expressing the hope that preparation for any particular examination will be left entirely out of account. The conviction is forced upon us more and more that the examination system has a very serious degrading effect both upon the teacher and the student. It is natural that the student, whose prospects depend on passing some examination, has little inducement to take account of questions or new advances in science, however important they may be, if they are not to be found in the recognised text-books, while the teacher feels reluctant to refer to them, however hampered he may be by his inability to do so. Moreover, there is an ever-present temptation to learn a number of facts by heart, since most examinations are easily passed in this way. If time is taken to understand principles, although the student is hereby caused to think for himself, he may well find that some facts have to be neglected. Under the present system facts count for more than laws. It is to be feared that Prof. Stiles's book may lend itself to the mere committal to memory. The examination problem is undoubtedly one of great difficulty, and at present no satisfactory solution is in sight. It seems that, on the whole, a book frankly written for the teacher rather than for the student would be the more useful for schools. In such a case more attention could be given to the experimental side. This does not really require elaborate and costly apparatus. It is astonishing what a wealth of significance there is in such a simple experiment as the burning of sugar in air and comparing the products with those given off in the breath.

A word must be said on the manner of dealing with the question of sex—a difficult problem for the teacher, but one that ought not to be shirked. Prof. Stiles's treatment is good, so far as it goes. But we are inclined to think that a reference to the physiological meaning and value of the union of two individuals as the basis of the discussion would go far to remove the mischievous way of looking at such problems which is almost universal.

The book is remarkably free from errors. We have detected only one serious mistake. On

p. 303 the fat resynthesised in the intestinal wall is stated to be different from the original fat hydrolysed in the cavity of the intestine. This is not the case.

(2) Dr. von Fürth's book is well known to many of us in the original as a valuable presentation of the facts of the subject at the time it was written. The use of the word "problems" in the title may cause a little disappointment to those who look for assistance in attacking difficult questions; something resembling Leathes's "Problems of Animal Metabolism" may have been expected.

It seems doubtful to the reviewer whether the translation of a general text-book is worth the trouble and expense unless the translator is possessed of the knowledge and capacity to bring it up to date. A new edition of the original work is almost certain to appear before the translation is exhausted, so that the latter prolongs the life of an antiquated edition, which is undesirable. The contents of the present book date from some time prior to 1913. On the whole, it is questionable whether any real necessity existed for its translation, since there are other books in the English language which serve the purpose. W. M. BAYLISS.

SOME MATHEMATICAL TEXT-BOOKS.

(1) *Dynamics.* By R. C. Fawdry. Part i. Pp. viii+177+ix. (London: G. Bell and Sons, Ltd., 1916.) Price 3s. net.

(2) *Differential and Integral Calculus.* By Dr. Clyde E. Love. Pp. xviii+343. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 9s. net.

(3) *Engineering Applications of Higher Mathematics.* By V. Karapetoff. Part ii. Pp. iv+103. Part iii. Pp. v+113. Part iv. Pp. v+81. Part v. Pp. vii+64. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 3s. net each.

(1) THIS is a text-book of elementary dynamics, leading up to circular motion. One naturally turns first to see how the foundations are treated, and here we must confess to some disappointment. Various experiments with a "trolley-apparatus" are quoted, and are used as a basis for the fundamental inductions. As a matter of fact, dynamics did not begin in this way, but with the testing of hypotheses. Such experiments are useful and instructive enough, as verifications, at a somewhat later stage; but they are too rough and too liable to error to serve as the basis of dynamical faith. They are also necessarily indirect, and various assumptions have to be made before they can be regarded as bearing specifically on the points they are meant to illustrate. The article on "mass" also is vaguely worded, and scarcely adequate to its purpose. Nevertheless, the book has points which may make it useful to a teacher who takes the theory largely into his own hands. The examples are well chosen and of the right standard of difficulty, and there are good exemplifications of such things as relative motion and centrifugal force.

(2) This book gives an account of the calculus from the first elements to the theory of ordinary differential equations. It includes also chapters on the applications to geometry and mechanics. Since the whole takes up only some 300 pages, it will be seen that the treatment is necessarily concise. It can, however, be recommended as a good introduction to the subject, and it is doubtless intended that it should be supplemented by plentiful oral comment. The examples are of a simple character, and bear directly on the text.

The book, naturally and properly, having regard to its scale, does not attempt to deal with the more abstruse logical points which present themselves in the beginning of the subject. The author is, however, to be congratulated on the practice he has generally adopted of stating explicitly when he makes an assumption which it is not convenient to stop and prove. There are two respects in which he has, we think, been unduly conservative. The treatment of the exponential and logarithmic functions and of their derivatives scarcely brings out the special importance of the former function, the logarithm being practically used as the primary conception. The proof of Taylor's theorem, again, is of the usual indirect and artificial character. One cannot but feel sympathy for the type of student whom Todhunter tried (vainly, we hope) to placate with the somewhat cruel remark that "he must not, while engaged in the elements of a subject, expect to be able, as it were, to *rediscover the theorems for himself.*" It is no doubt difficult to present these matters in a way at once natural and fairly rigorous, but the attempt should be made.

(3) We have here four parts of a work on the application of higher mathematics to engineering. In the words of the author:—"The book may be called a summary of the most common engineering applications of higher mathematics, or a mathematical cross-index to engineering text-books. It fulfils its purpose if it saves the teacher the trouble of consulting many engineering books for the purpose of selecting a few mathematical problems for his students. The author also hopes that the book may stimulate interest in higher mathematics among his fellow-engineers." It should be said that the term "higher" is used in rather a restricted sense, and that the reader will find many quite elementary things explained to him. For example, it is formally proved that the minimum value of $x+y$ subject to the condition $xy=$const. occurs when $x=y$; this with the help of the calculus!

The four slender volumes before us deal with hydraulics, thermodynamics, elasticity, and electricity respectively. The treatment is, on the whole, sound, though the diction is often rather loose. For instance, it is not easy to justify the offhand statement that the internal stresses in a cross-section of a beam are proportional to the bending moment, "since the action of these forces is to bend the beam." The mathematical work is not distinguished by neatness, and one finds awkward and cumbrous proofs where often quite

simple methods are available. The author appears afraid of making undue demands on the knowledge of his readers, and when a real difficulty occurs contents himself with a reference to a textbook.

The treatment of the strength of thick cylinders and spheres may be cited as characteristic. The final formula is evolved as the result of five successive approximations, and the whole investigation takes up twenty-four pages. Would it not be really simpler, as well as much shorter, to give the well-known correct investigation at once? It is a little more difficult, but there are no precarious assumptions, and by the time he had mastered it the engineering student would really know something about stresses and strains.

These criticisms must not be taken to reflect on the competence of the author, whose aims, as recorded in his prefaces, are excellent. But he does not seem to have a high opinion of the attainments of the class of students whom he addresses.

OUR BOOKSHELF.

The Problem of Pain in Nature. By C. F. Newall. Pp. 131+7 illustrations. (Paisley: Alexander Gardner, 1917.) Price 3s. 6d. net.

THIS little book may be useful to those who are troubled in spirit by what they believe to be a fact: that animals in wild life suffer much pain. Mr. Newall explains in a simple way why he regards this shadow on Nature as, on the whole, of man's imagining. For the humblest animals "no brain, no pain" seems good sense; and animals of the little-brain type, such as insects, the behaviour of which is predominantly reflex and instinctive, often go on as if they were callous to serious injuries. A dragon-fly which has lost its hindquarters is not thereby hindered from eating a good many flies, and finishing up with its own lost parts.

We cannot, of course, be sure how much sensation of pain there is among invertebrates, but Mr. Newall's quiet consideration of the facts suggests that there is but little. When we pass to vertebrate animals the argument from analogy becomes more trustworthy, and Mr. Newall refers to the experiences of men who have been in the grip of wild beasts without feeling much, if any, pain or fear.

In most cases in wild life the *coup de grâce* is instantaneous. It may be argued, indeed, that Nature is rich in efficiencies that lessen the chance of pain. Selous was strongly of opinion that Wallace erred in his low estimate of the evolution of pain-sensations among animals, but he himself attached too much importance to cries and the like. Many a one might conclude from a baby's cries that the mother was slowly torturing it. We think that there is good sense in Mr. Newall's conclusion that men have greatly exaggerated the prevalence of pain in Nature, but we are afraid of some of the arguments, for they seem also to banish pleasure. In a short book like this the reader should be spared "amydallin," "etherial," "Eperidæ," "Barlett," and "Sir James Lister," which we happened to notice.

The Elements of Engineering Drawing. By E. Rowarth. Pp. xii+131. (London: Methuen and Co., Ltd.) Price 2s. 6d. net.

THE main purpose of this book is to give examples of, and instruction in, the art of draughtsmanship, for the benefit of young students just entering on an elementary course of engineering. It is intended as a corrective to the unworkmanlike finish and execution which are apt to accompany a too exclusive use of models and machine parts, with their dimensioned sketches, in the teaching of machine drawing.

The general treatment of the subject is somewhat meagre and crude, but the plates are executed in a style that would be approved by the professional draughtsman; the instructions annexed to each plate are full and precise, being helped by pictorial views; and the book seems to be specially suitable for dealing with large classes of junior students where it is not practicable to give much individual attention.

The text is divided into four sections relating to the manipulation of instruments, the method of projection, and the forms and proportions of the commoner machine fastenings, with examples of their use.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

British Optical Science.

As a manufacturer, may I be allowed to reply to Sir Joseph Larmor's letter in NATURE of March 1 on the subject of British optical science, in which he makes certain statements that must create an entirely wrong and unfortunate impression of the circumstances?

What is the reason for the comparative smallness of the British optical industry? If one considers the pre-war output of the important German firms, it will be seen that they are based upon their military departments of which the public of other countries knows very little. It only knows the German firms by their civilian productions. The German War Office in peace-time issued large orders for optical instruments and placed them with German firms, on the principle that the optical industry would be a vital one in time of war. Having such large orders to deal with, and having the certainty of continuity of work, the German firms were enabled to develop special machinery and appliances and to develop their general organisation.

As suppliers of the largest Continental Army, the German firms naturally obtained the bulk of the orders of other Armies, with a consequent increase of their facilities and experience. In such circumstances it was comparatively easy to establish and maintain a civilian world trade.

Consider now the British conditions. The pre-war British orders were of negligible importance compared

with the Continental ones. Where single orders for thousands were received by Continental firms from all sources, British firms received orders for tens. Anyone who is familiar with industry knows how difficult it is to compete with large firms under such conditions.

During the war, however, the British optical firms have received large and continuous orders, and as a result the increase of output has been very great. To have rushed a small industry in war-time and in so short a period up to its present size is a marvellous performance, probably unsurpassed in any other industry demanding exceptional skill.

But the important points to observe are that, so far as their knowledge was concerned, the principal British firms were competent to undertake the work, and that, having the orders, they were able to erect new premises, install plant, provide special jigs and tools, train unskilled labour, find suitable materials, and in these extraordinary circumstances to produce instruments that satisfy the requirements of the Services.

If in peace-time military orders of reasonable size had been placed in this country, the optical industry would have dealt with them as it has during the war. It is largely a question of orders of reasonable size and, above all, continuity of orders.

Having pilloried the optical manufacturer, Sir Joseph Larmor proceeds to praise the British optical writers. It is suggested that their works contain information that the manufacturers lack.

In Germany and in Britain it is not the type of book cited by Sir Joseph Larmor that is used by the optical manufacturers. Not one of the books cited deals with the method of optical computation actually adopted in the German workshops, and, indeed, there are extremely few books in Germany that do divulge the whole system. The British books are, no doubt, well adapted to enable students to pass examinations on general optics. For example, one of the best of those cited has a large index, which includes the rainbow and the principle of relativity—questions no doubt that will find a place of honour in examination papers—but which does not refer to so vital a question as coma, to which alone a whole book should be devoted.

There is a great similarity in the present optical books. They all contain the same stereotyped material. Some deal with it in a non-mathematical way, while others attack the propositions with heavy algebraic artillery. Generally the sign convention changes without warning from page to page, for the simple reason that the matter is mostly copied from previous writers who used no standard system.

No doubt these books are the unfortunate result of circumstances. A book devoted to, say, coma would have a very limited market, whereas a book on optics, if made sufficiently general, can be made to appeal to students and school teachers and thus find a profitable market.

In the early days of the optical industry in this country our pure mathematicians were also real craftsmen. They were not content with the evolution of general equations. To day "the science of the best optical instrument makers is far ahead of the science of the text-books." That is the opinion of the late Prof. Silvanus P. Thompson, who also said: "But the teaching of the colleges and the university teaching at Cambridge—well, what is it in optics? They call it optics, but it is really purely mathematical gymnastics applied to the optical problems of a hundred years ago. I do not think there is really what one can truly call optical work going on at Cambridge. . . . Optical teaching, I am sorry to say, is very largely at its lowest conceivable ebb."

If our present-day mathematicians wish to help the industry (and their help is desired), they must enter the workshops first as learners, not teachers. They may find the work laborious and monotonous from the point of view of the mathematician to whom a pretty solution is an object of importance, but once they have experienced the pleasure of testing a system that accords with their calculations, they will never again be satisfied with the publication of untried formulæ.

James Weir French.

Anniesland, Glasgow, March 28.

Floating Earths.

In reference to the inquiry of Dr. Walter Leaf in Nature of March 15 as to the interpretation of a passage of Strabo, the fact may possibly be of some interest that in the island of Mors, in Denmark, bricks are made from a local sandy clay which, after burning, float in water. These bricks are used, I understand, both as a refractory material and for ordinary building purposes, their lightness and porosity giving them certain advantages for the latter purpose. Their mechanical strength is said to be considerable. The porosity is not obtained by the addition of combustible or volatile matter during moulding.

If the expression πηγνυμένας, used by Posidonius, be consistent with a process of burning the clay into bricks, and if clays of somewhat similar physical character to that of Mors, although of different geological origin, occur in Asia Minor and Spain, an explanation of the passage might perhaps be found in this direction.

Cecil H. Desch.

Metallurgical Laboratory,
University of Glasgow,
March 24.

Gravitation and Thermodynamics.

If Dr. P. E. Shaw's contention (Nature, March 29) for a perpetual motion consequence of gravitational heat were justified, it would be an argument against the supposed effect on which such a conclusion could be based; but it does not seem to me that the contention is justified. For the line joining maximum to minimum temperature is vertical, and, unless the rate of heating differs from the rate of cooling, every horizontal chord will be an isothermal; so there is nothing to keep a vertical disc rotating.

Oliver Lodge.

The suggestion in Nature of March 1 that thermodynamics might throw light on the question of the temperature variation of gravitation has not been unkindly received. The criticisms have not been directed so much against this suggested application of thermodynamics as against the expression deduced for the attraction between two bodies.

It has been pointed out to me that dQ is not a perfect differential, and therefore it is not valid to equate

$$\frac{\partial^2 Q}{\partial r . \partial \theta} = \frac{\partial^2 Q}{\partial \theta . \partial r}.$$

The correct expression for the attraction, assuming that the specific heat is independent of r, is

$$F = m . \theta . f(r) + \psi(r),$$

where m is the mass of the body the temperature of which is θ. This expression has none of the objections which the previous incorrect expression had, for at the absolute zero the temperature coefficient vanishes and $\psi(r)$ is probably $GMmr^{-2}$.

The assumption that $\partial s/\partial r = 0$ is, of course, only a special case, for s may depend on r or on the gravitational field in which the mass m is situated. Since

the introduction of comparatively small masses on the earth's surface would have no perceptible effect on the gravitational field, s may be taken as constant in any experiments on the earth's surface.

Dr. P. E. Shaw (NATURE, March 29) argues that my hypothesis involves a violation of the conservation of energy. To avoid the difficulty of perpetual motion I would suggest making $\partial Q/\partial r$ positive instead of negative. This will not alter the expression for F, but the turning moment on Dr. Shaw's disc will then bring it to rest. GEORGE W. TODD.

Newcastle-upon-Tyne.

THERMIONIC DETECTORS IN WIRELESS TELEGRAPHY AND TELEPHONY.

THE arts of wireless telegraphy and telephony involve the use in the receiving circuit of some device named a detector, which is sensitive to electric oscillations of very high frequency. In the earliest years of radiotelegraphy the appliance used was the so-called coherer, in which a small mass of metallic filings or an imperfect contact between two pieces of metal was converted into a better conductor by the passage through it of the high-frequency oscillations. All the various forms of coherer have now been abandoned and are no longer used as detectors. In modern radiotelegraphy, so far as regards the spark or damped-wave system, only three types of detector are at present in practical use. The first of these is the magnetic detector, chiefly the rotating band form, invented by Marconi; the second type is some form of rectifying contact or crystal, such as the carborundum detector due to Dunwoody, or the zincite-chalcopyrite rectifier of Pickard; and the third is some modification of the thermionic detector, or Fleming oscillation valve.

In the magnetic detector the electric oscillations to be detected are caused to circulate round a magnetised iron wire and alter its magnetic permeability or hysteresis in such a fashion as to create a sudden change in the magnetisation of the iron. This in turn is made to create an induced electric current in a second coil and reveal itself by a sound made in a telephone in series with that coil. The rectifying contacts or crystals depend upon the fact that a contact of small surface between certain substances, generally crystalline, has a greater electric conductivity in one direction than in the other. Hence, if such a contact as that, for example, between a fragment of zincite or native oxide of zinc and a piece of chalcopyrite or copper pyrites is traversed by a train of electric oscillations, these will be converted into a movement of electricity chiefly in one direction. Accordingly, if a rapid sequence of such oscillations passes through such rectifying contact placed in series with a telephone receiver, the latter will be traversed by a series of intermittent gushes of electricity in the same direction, and will emit a sound the pitch of which is determined by the group frequency of the oscillations. A very commonly used rectifying contact is a crystal of carborundum, or carbide of silicon, held between metal clips. Although this rectifying property of certain contacts and crystals has been much studied, the reasons for it are not yet fully elucidated, but it is probably connected with the thermoelectric properties of the materials.

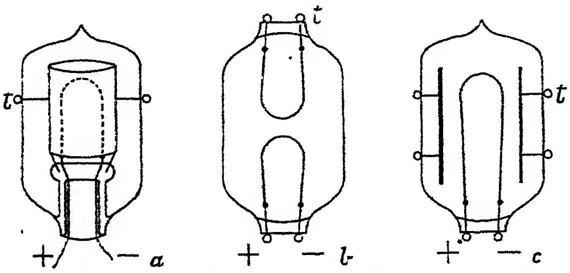
The third type of detector is the thermionic detector first suggested and used by Dr. J. A. Fleming, of University College, London. The construction and mode of operation of this form of detector may be briefly described as follows:—It had been known for many years prior to the advent of radiotelegraphy that the electric conductivity of a highly rarefied gas was greatly determined by the temperature of the negative electrode by which the current left the exhausted vessel containing it. It had been found by Hittorf and also by Elster and Geitel that if the negative electrode was a platinum wire which could be rendered incandescent, the conductivity of the highly rarefied gas was greatly increased. The emission of positive and of negative ions from incandescent solids *in vacuo* had been studied particularly by Elster and Geitel, beginning in 1880.

In 1884 Edison made known an interesting fact connected with carbon-filament glow-lamps. He sealed into the bulb of one of his bamboo-filament lamps a metal plate placed between the legs of the horseshoe-shaped filament, the said plate being carried on a platinum wire sealed through the glass bulb. He found that when the filament was rendered incandescent by a continuous current, a galvanometer connected between the terminal of the plate and the external negative terminal of the filament indicated no current, but that if connected between the plate and the positive filament terminal, it showed a current of a few milliamperes. Edison gave no explanation of this, nor did he make any application of the discovery. He supplied a certain number of lamps made with middle plates to the late Sir William Preece, and the latter communicated to the Royal Society in 1885 a paper describing various experiments with these lamps. This "Edison effect" was more completely examined by Dr. J. A. Fleming in researches described by him in papers to the Royal Society in 1890 and to the Physical Society in 1896. Dr. Fleming showed that the effect was in some way due to the scattering of particles charged with negative electricity from the hot filament, and that it could be prevented by enclosing the negative leg of the carbon in a glass tube, or placing a sheet of mica between the carbon and the plate. He also proved, as Elster and Geitel had done in another way, that a vacuum tube having two carbon filaments as electrodes had a very large conductivity for small voltages when the negative electrode was made incandescent.

It was not until 1899, when Sir J. J. Thomson announced his epoch-making discovery of electrons, or corpuscles smaller than atoms, carrying a negative charge, that it was clearly recognised that incandescent solids in high vacua emit electric ions, some positive and some negative.

This electronic emission from hot bodies has

been very fully investigated by Prof. O. W. Richardson, who has collected most of the known facts in an excellent manual on the subject. None of the investigators of this subject made any practical application of this knowledge until it occurred to Dr. Fleming in 1904 to employ an incandescent electric lamp having one or more plates or cylinders of metal sealed into the bulb as a means of detecting high-frequency electric



. 1.—Various forms of Fleming oscillation valve or thermionic detector used in wireless telegraphy.

oscillations, as used in radiotelegraphy. Accordingly he constructed such electric glow-lamps with carbon filaments and a metal plate or cylinder surrounding, but not touching, the filament, the said cylinder being attached to a platinum wire sealed through the bulb (see Fig. 1). He employed this device as follows:—The carbon filament in the lamp O (see Fig. 2) is rendered in-

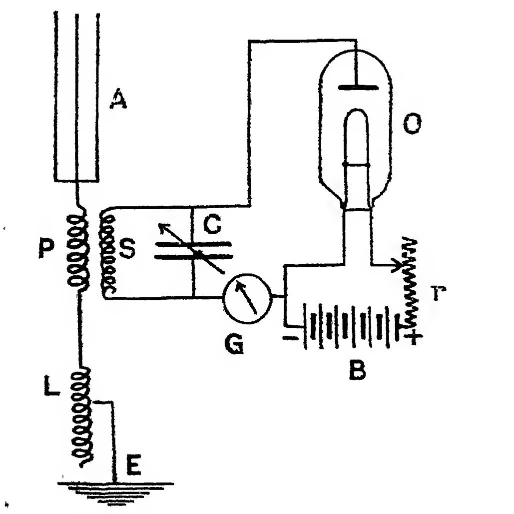


FIG. 2.—One mode of employing the oscillation valve as a detector in a radiotelegraphic receiving circuit. A, antenna; P S, oscillation transformer; C, condenser; O, oscillation valve; B, battery; G, current-detecting instrument.

candescent by a suitable battery of storage cells, B; most usually a 12-volt or 4-volt filament is employed. A circuit is formed external to the bulb by connecting the metal plate or cylinder to the negative terminal of the lamp. In this circuit is placed a current-detecting instrument, such as a galvanometer, G, or a telephone. In the circuit is also inserted the secondary circuit of an oscillation transformer, P, S, the terminals of which are closed by a condenser, C (see Fig. 2).

If electric oscillations are created in the above circuit, the alternations of current are rectified: that is to say, a unidirectional current flows through the galvanometer or telephone. The highly vacuous space between the incandescent filament and the metal cylinder inside the bulb possesses a unilateral conductivity. When the filament is at a very high temperature negative electricity can pass from the filament to the plate, but not in the opposite direction. Hence the device acts as a valve and was called by Dr. Fleming an oscillation valve. Another way of viewing the effect is as follows:—When the electric oscillations take place through the condenser, the plate or cylinder in the bulb tends to become charged alternately positive and negative. The incandescent filament is continuously emitting negative ions or electrons, and these at once discharge any positive charge on the metal plate, whereas they do not discharge a negative charge. There is, therefore, a continuous movement of positive electricity to the plate from outside the lamp. If the electric oscillations are in trains of damped groups, then the effect is to convert them into gushes of electricity in one direction which pass through the telephone. If these groups come at the rate of several hundred per second the telephone receiver emits a continuous sound of corresponding pitch, and if the groups are cut up into Morse signals at the sending end, the listener at the telephone hears these signals as long and short sounds.

An electric incandescent lamp with metal plates, grids, or cylinders in the bulb is now called a thermionic detector, because it serves to rectify and render detectable by a galvanometer or telephone receiver the feeble electric oscillations used in wireless telegraphy or telephony. It depends for its action upon the emission by the incandescent filament of electrons, or thermions as they are termed.

Dr. Fleming found that a tungsten filament was of special utility for this purpose. The thermionic receiver has great advantages in that it is not injured or put out of adjustment, like crystal detectors, by powerful electric oscillations or atmospheric discharges acting on its receiving circuits.

In some of Dr. Fleming's experiments he employed an incandescent lamp with two plates sealed into the bulb carried on separate terminals. An illustration of such a double-anode or two-element valve was given by him in a paper published in the Proceedings of the Royal Society early in 1905 (see *c*, Fig. 1). The new thermionic detector naturally attracted the attention of radiotelegraphists, and amongst others of Dr. Lee de Forest in the United States. After adopting the detector in substantially the same form, Dr. de Forest patented in 1907 a modification in which the two metal electrodes were sealed into the vacuous bulb, in addition to the metallic or

carbon filament to be rendered incandescent. One of these electrodes was in the form of a plate, and the other of a grid or zigzag of wire interposed between the filament and the plate. In using this double-plate thermionic detector, Dr. de Forest connected the grid terminal to one side of the receiving circuit condenser, and the negative terminal of the filament to the other side of the same condenser; but, instead of inserting the telephone or current-detecting instrument in this grid circuit, he included it in a separate external circuit connecting the plate with the filament, and placed in this circuit also a battery with negative pole connected to the filament (see Fig. 3).

Dr. de Forest called this arrangement an *audion*, and maintained that the physical action was different from that of the Fleming valve, though valves with two anode plates had already been in use for certain experiments. It has been shown, however, to be essentially the same. It is clear that the performance of the audion as a radiotelegraphic detector depends entirely upon the thermionic emission from the incandescent filament. It has been demonstrated by Dr. E. H. Armstrong in a paper in the Proceedings of the Institute of Radio-Engineers for September, 1915, that the physical actions taking place in the grid circuit of Dr. de Forest's audion are precisely the same as in those in the Fleming valve.

The thermionic emission of negative ions causes the grid to become negatively charged. On the other hand, the battery in the external circuit connected to the plate sends a thermionic current through the vacuous space between the filament and the plate inside the bulb, in virtue of the incandescence of the filament or negative electrode. This current flows also through the telephone or current-detecting appliance. When the grid becomes negatively charged, due to the rectification of electric oscillations impressed upon the grid circuit, it reduces the thermionic current flowing between the filament and the plate, and therefore varies the current through the telephone. The physical actions which contribute to the operation are therefore all dependent upon the thermionic emission from the filament and upon the increased unilateral conductivity of a highly rarefied gas or vacuous space when the cathode or negative electrode is rendered incandescent.

This action is not necessarily dependent upon the presence of any residual gas in the bulb, because even in a highly perfect vacuum the electronic emission from the incandescent filament would take place.

The double-anode Fleming valve, or the valve with grid and plate, called an audion, has the property that an amplification of current variation can be produced by it.

Thus, if the grid-plate thermionic detector is arranged as in Fig. 3, feeble electric oscillations taking place in the grid external circuit can be made to produce large variations in the continuous current flowing in the external plate circuit.

Moreover, by connecting two or more such double-anode thermionic detectors in series, the current in the plate circuit of one, acting inductively on the grid circuit of the next, enables a double amplification to be produced.

Furthermore, such double-anode thermionic valves can be used as generators of electric oscillations by inductively connecting through a suitable transformer the grid and plate circuits *g* and *h*

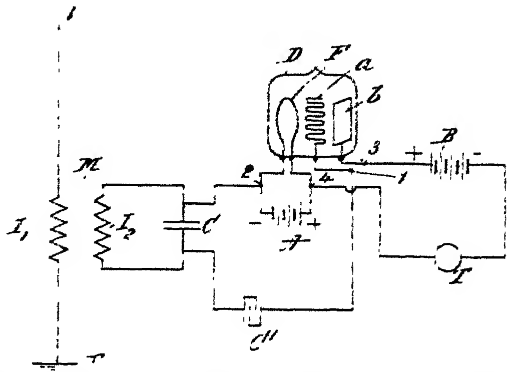


Fig. 3.—De Forest audion or form of thermionic detector. D, bulb of glow-lamp; F, incandescent filament; *a*, grid; *b*, plate; T, telephone; A, B, batteries; C', C'', condensers.

of one and the same bulb V (see Fig. 4). The arrangement then acts as follows:—Feeble electric oscillations set up in the external plate circuit by any means create induced oscillations in the grid circuit, and the latter sustain and enhance the former, the energy to create these enhanced oscillations coming from the battery in the plate circuit.

The process exactly resembles that in which a

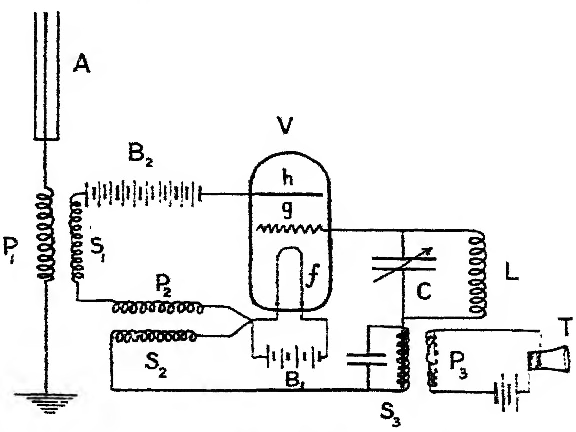


Fig. 4.—Mode of using double-anode valve or thermionic detector as a generator for electric oscillations.

Bell telephone receiver in circuit with a battery and carbon microphone transmitter emits a continuous musical note when the diaphragm of the receiver is held near that of the transmitter. Feeble vibrations are set up in the microphone diaphragm by noises in the room, and these vary the current through the telephone receiver, and the sound so emitted keeps the transmitter diaphragm in motion.

Again, the double-anode valve can be used as a telephonic relay in ordinary telephony to magnify and repeat sounds.

The oscillation valve is not simply a detector; it is a quantitative detector, and hence has been extensively used as a receiver in all experiments in wireless telephony. In fact, most of the successful long-distance experiments in radiotelephony have been conducted by it. For when so used it rectifies the continuous high-frequency oscillations in the receiving circuit into a direct current. Hence the variations in amplitude in these oscillations which are produced by the microphone in the transmitter circuits make themselves evident as variations in the rectified current which flows through the telephone receiver, and these reproduce the sounds of the speech made to the microphone in the transmitter. This thermionic detector promises, therefore, to be of great use in the solution of the problem of radiotelephony, as well as that of repeating or relaying ordinary telephonic currents.

THE INDIAN SCIENCE CONGRESS.

THE Indian Science Congress held its fourth annual meeting in Bangalore on January 10 and the three following days, under the presidency of Sir Alfred Bourne, F.R.S. The six sections—those, namely, of Mathematics and Physics, Chemistry, Agriculture, Botany, Zoology, and Geology—met in the mornings, and in all seventy-two papers were read. It is obviously impossible, in the space available for this notice, to give an account of the work of the various sections or even to enumerate the papers, but certain points in connection with the present meeting are deserving of mention. Two of the sectional presidents departed from the usual custom in giving addresses on general topics. In the Mathematics and Physics Section the Rev. Dr. Mackichan referred to the great value of early Indian contributions to mathematics, both pure and applied, but deprecated the suggestion put forward by some enthusiasts that there was no scientific truth of importance that could not be traced in the ancient Hindu scriptures. The other address, given to the Chemistry Section, is referred to below.

There was a comparatively large proportion—about one-third of the total number—of papers dealing with the application of science to particular industrial problems. The increase in the number of papers of this kind is undoubtedly due to war conditions, which have stimulated industrial enterprise in many parts of India. The papers on industrial science read at meetings of the Congress represent but a small part of the work which is being carried on in different parts of the country; those on pure science, on the other hand, record very nearly the whole of what is being done in Indian colleges, and one cannot help noticing their fewness. The causes of the paucity of research work were examined by Dr. J. L. Simonsen in his presidential address to the Chemistry Section. Lack of proper training in past years, understaffing of colleges—resulting in a man's whole time being taken up by routine work—and inadequate pay in subordinate grades of the teaching profession were mentioned as among the most important; and to these must be added the absence of the research atmosphere that is so marked a feature of the larger English educational centres. The Indian Science Congress constitutes at present the only means of remedying this situation effectively. It can, through the proper official channels, direct the attention of the Imperial and local Governments to those defects of the present system which it is in their power to remedy; it can also provide once a year the research atmosphere and facilities for discussion and criticism which are lacking in the colleges, partly because the great distances which separate them make the personal exchange of ideas almost impossible, and partly because, excepting a few agricultural research stations, not more than one or two men are working at the same subject in any one place.

Although the actual amount of research in pure science is small, it is large when compared with what was being done four years ago. At the first meeting of the Congress in 1914 only twenty papers were read: the number this year had increased to seventy-two. This year, too, a new rule was in force, making it necessary for authors to submit their papers to a referee. While in some of the sections—that of Zoology, for example—the quality of the papers was excellent, this is not true of all. There were a number of papers from a certain quarter that appear to have been inspired by a determination to produce the maximum quantity of "research" in a given time. Work of this type falls into its proper place in the course of the discussion and criticism which take place in the sectional meetings, and there is no doubt that the Congress is doing a good deal towards setting up a higher standard of work than exists at present.

An interesting discussion took place, under the chairmanship of Sir Sydney Burrard, F.R.S., on scientific libraries in India, following some suggestions which had been made to the effect that research work in India was sometimes hampered by inability to obtain references. It appeared from the contributions to this discussion that the difficulty was felt chiefly by zoologists, to whom plates and diagrams were frequently of greater importance than the text of a paper (which could always be copied and sent by post). But the general feeling was that any lack of library facilities in India could scarcely be considered a contributory factor in hindering research, and that the existing needs would be adequately met by the preparation of a catalogue showing the periodicals available in different places and the rules under which they could be lent or copied.

The remaining activities of the Congress may be briefly mentioned. Three public lectures were delivered, and were attended by large audiences. The first was by Mr. C. Michie Smith on "The

Sun," and this was succeeded by a lecture on "Soaring Flight" by Dr. E. H. Hankin, and one by Mr. F. L. Usher on "Explosives." The only social function took place on the afternoon of January 11, when the members were received at the palace by H.H. the Maharajah of Mysore, to whose Government the Congress is indebted for the invitation to meet this year in Bangalore. On the following afternoon the members visited the laboratories of the Indian Institute of Science at the invitation of the director and staff.

At the concluding business meeting it was announced that the Congress would meet next year in Lahore, under the presidency of Dr. Gilbert Walker, F.R.S. F. L. U.

NOTES.

WE regret to learn from the *Times* that the death of Dr. E. von Behring, the discoverer of the curative effect of the serum of immunised animals in the treatment of diphtheria, is announced in the German newspapers.

THE annual general meeting of the Chemical Society was held at Burlington House on March 29, Dr. Alexander Scott being in the chair. Prof. W. J. Pope was elected president, Col. Smithells and Prof. Sydney Young were the two new vice-presidents elected, and Prof. H. C. H. Carpenter, Prof. A. Findlay, Prof. A. Harden, and Dr. T. A. Henry were elected as new ordinary members of council. Dr. Scott delivered his presidential address upon the subject of "The Atomic Theory."

A NEW branch of the Ministry of Munitions has been established under Sir Lionel Phillips as Controller, to deal with the examination and development of such mineral properties (other than coal or iron ore) in the United Kingdom as are considered likely to be of special value for the purposes of the war. The Minister of Munitions has appointed the following to act as an advisory committee on the development of mineral resources:—Sir Lionel Phillips, Bt (chairman), Mr. F. J. Allan, Mr. C. W. Fielding, Mr. R. J. Frecheville, Prof. F. W. Harbord, Mr. F. Merricks, Sir Harry Ross Skinner, Dr. A. Strahan, and Mr. Edgar Taylor, together with a representative to be nominated by the Board of Trade.

WE learn from *Science* that Prof. A. V. Stubenrauch, professor of pomology in the University of California, died at Berkeley, Cal., on February 12. A graduate of the University of California of 1899, Prof. Stubenrauch was for ten years in the U.S. Department of Agriculture, resigning in 1914 his position as pomologist in charge of field investigations to return to service in the University of California. He was the first to demonstrate that dates could be grown with commercial success in the Imperial Valley, on the desert in southern California; and in association with Mr. G. H. Powell he developed the pre-cooling method, which has greatly contributed to success in the shipping of fruit from California.

A KINEMATOGRAPH film of great interest is now being shown at the Philharmonic Hall, Great Portland Street, by Capt. Campbell Besley. Capt. Besley, who is an Australian, undertook an expedition to the head waters of the Amazon at the request of the President of Peru in co-operation with Mr. Bryan, then Secretary of State of the United States of America. The chief objects of the expedition were to determine the source of the Amazon and to ascertain the fate of former explorers, who were supposed to have been killed by hostile Indians. The expedition, which was away two years, achieved its objects, but at considerable cost of life, for of the twelve white men who started only four returned. Several fell victims to the poisoned arrows of the natives. The pictures, which are explained by Capt. Besley, show the great rivers, the vegetation, and animal life of the region visited. They are an example of the great educational value of the kinematograph. The film is at present shown daily at 3 and 8 p.m.

THE seventieth annual meeting of the Palæontographical Society was held on March 30 in the Geological Society's rooms, Burlington House, Dr. Henry Woodward, president, in the chair. The report referred to the delay of the publications owing to existing circumstances, but noted that there was no diminution in the number of monographs offered. Instalments of the volumes on Pliocene Mollusca, Palæozoic Asterozoa, and Wealden and Purbeck fishes were about to be issued. Dr. Henry Woodward, Mr. R. S. Herries, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively, and the new members of council were Mr. H. A. Allen, Mr. E. Heron-Allen, Rev. H. N. Hutchinson, and Mr. C. T. Trechmann. In a brief address the president mentioned that when the society was founded on March 23, 1847, it was estimated that the description and illustration of all the British fossils could be completed in twenty-five years. The long series of volumes published during seventy years, however, had proved to do little more than make a good beginning of the task.

ON Thursday, March 29, a representative assembly of the friends and admirers of the late Sir William Huggins, O.M., and Lady Huggins met together in the crypt of St. Paul's Cathedral to witness and participate in the unveiling and dedication of a medallion commemorating conjointly the achievements of a great astronomer and the inspiring efforts of a wife who, for some thirty-five years, identified herself with his aims and labours. Among those present were Sir Joseph Thomson, O.M., president of the Royal Society; Dr. A. Schuster and Mr. W. B. Hardy, secretaries R.S.; Sir Alfred Kempe, treasurer R.S.; Sir Archibald Geikie, O.M.; Major MacMahon, president of the Royal Astronomical Society; the Astronomer Royal; Sir W. Crookes, O.M.; Mr. H. F. Newall; Sir Joseph Larmor; Mr. E. B. Knobel; Sir W. Tilden; Mr. E. W. Maunder; Mr. W. H. Wesley; and the Rev. T. R. R. Stebbing. A number of ladies were also present. After the memorial had been unveiled a short form of service was conducted by Dean Inge, with whom were Canon Simpson and Canon Alexander. In committing the memorial to the charge of the Dean and Chapter, Sir Joseph Thomson paid eloquent tribute to the scientific achievements of Sir William Huggins. Born and educated in London, and all his work having been carried on and issued from a London observatory, St. Paul's appeared the fittest of destinations for a medallion. Major MacMahon, referring to certain points in a great life, said that Huggins saw celestial chemistry looming in front of him, and before many years had elapsed he was the pioneer of a new branch of science. The medallion of Sir William Huggins, it should be noted, was the primary object of the memorial, but, on the death of Lady Huggins, it was decided to place her portrait beneath that of her husband, on the same slab. Both are the work of Mr. Henry Pegram, A.R.A. The inscriptions run respectively: "William Huggins, Astronomer, 1824–1910"; "Margaret Lindsay Huggins, 1848–1915."

Second Lieut. Cyril Douglas McCourt, who lost his life while gallantly leading a bombing attack in France on October 8, 1916, was born in 1883, and educated at St. Charles's College, North Kensington, whence he gained an institute scholarship at the City and Guilds of London Central Technical College, now part of the Imperial College of Science and Technology. After gaining the college associateship in chemistry, he served for a brief period as private assistant to Prof. H. E. Armstrong. In 1903 he was appointed chief chemist to the Morgan Crucible Co., Ltd., and during the six years that he held that post he carried out a number of valuable investigations bearing upon the manufacture and uses of various refractory materials, but the outstanding feature of his work was the part he played in the invention and subsequent development of the Morganite brush for dynamos and motors. This brush possesses exceptionally good lubricating and commutating properties, which are principally due to the comparatively low temperature at which it is burnt during its process of manufacture. In 1909 Mr. McCourt resigned his appointment with the company in order to work out, in collaboration with Prof. W. A. Bone, in Leeds, the industrial applications of the phenomenon now known as "incandescent surface combustion," a field of technical research which strongly attracted him, and afforded him ample scope for turning to good account his considerable knowledge of refractory materials. This collaboration speedily resulted in the many important scientific inventions comprised under the "Bonecourt" surface combustion system, the value of which has been more appreciated in America and Germany, where already considerable developments have been successfully worked out, than in the country in which they originated. Mr. McCourt showed great versatility and ingenuity in all his experimental work, to which he was passionately devoted, whilst his frank and generous nature was highly valued by all with whom he came in contact. Shortly after the outbreak of war he abandoned his research work in order to join the Army, where he anticipated that his scientific training and experience of the management of men would stand his country in good stead. His death is a real loss to science.

Dr. J. W. Fewkes has reprinted from the Holmes anniversary volume an interesting monograph on the remarkable cliff-ruins in Fewkes Cañon, Mesa Verde National Park, Colorado. The author was deputed in 1915 by the Smithsonian Institution to continue the work of excavation and repair of these buildings. A report on the general results of the work was published under the title of "Excavation and Repair of the Sun Temple." In the course of the season's work he also excavated and repaired a cliff-dwelling, called Oaktree House, the results of which are described in the present publication. A plan of this building, which cannot be called characteristic, but resembles that of Spruce-tree House and other cliff-houses in Mesa Verde Park, is given. In another building, known as the Painted House, a series of representations of men and animals was discovered. The monograph is complete and well illustrated, and gives much information on the religious cults of the builders.

Dr. Maynie R. Curtis continues (*Biol. Bull.* xxxi., No. 3) previous interesting studies in the "Physiology of Reproduction in the Domestic Fowl" with a paper on double eggs. From the observations given it appears that an egg, after having received its membrane or its membrane and shell, may be propelled up the oviduct instead of being laid. In such case it may, on re-entering the terminal part of the duct, stimulate the secretion of another set of envelopes around those already formed, or, if it meets its successor, return along with it, and with it become enclosed in a common set of envelopes.

A useful vegetation map of the United States by Mr. F. Shreve, of the Arizona Desert Laboratory of the Carnegie Institution, is published in the *Geographical Review* for February (vol. iii., No. 2). The map, which is produced in colours, differs in some respects from previous maps, and shows eighteen vegetation areas. The basis of the classification is, as usual, desert, grassland, and forest. Of these the desert and the forest are subdivided, but the natural grassland in want of data has been left as a single region. The local influence of soil has been ignored so far as possible. The map forms a valuable basis for geographical work, and has the merit of steering a course between excessive detail valuable only to the botanist and wide generalisations which are a danger to geographical research.

A new method of expressing the representative fraction of a map is suggested by Mr. A. R. Hinks in a paper on British and metric measures in geographical work in the *Geographical Journal* for March (vol. xlix., No. 3). Mr. Hinks proposes to take the fraction of the "million" map, 1/M, as a unit and to write the representative fraction of all maps on a larger scale than 1/M as a fraction with M in the denominator and the proper numerator; thus 1/125,000 would be written 8/M, and 1/63,360 as 15·8/M. In maps on a smaller scale than 1/M the denominator would be expressed in M's; thus 1/1,680,000 would be written 1/1·68M. Mr. Hinks proposes that this system should be given a trial by adding it as an alternative to the ordinary form. It is certainly less inconvenient and easier to write than the large number of figures required in the usual representative fraction.

The first part of vol. xvi. of the Transactions of the Geological Society of Glasgow (1916, price 7s. 6d.) contains a presidential address by Prof. J. W. Gregory that deserves to be widely read, on "The Geological Factors Affecting the Strategy of the War and the Geology of the Potash Salts." The careful annexation of the Lorraine ironfield by Germany in 1871, and the equally far-sighted occupation of the best French coalfields since 1914, are judiciously pointed out. A summary of Everding's paper on the potash-salt area of Prussia includes sections not easily available. Other sources of potash are usefully reviewed, and to these alunite might now be added.

Now that the development of marine warfare has compelled every nation to look into its own resources, it is cheering to receive Mr. C. H. Clapp's report on the geology of the Nanaimo map-area (Mem. 51, Canada Geological Survey), in which a promising report is given of the Upper Cretaceous coals on Vancouver Island, directly opposite the terminus of the Canadian Pacific Railway. Though the ash is often about 9 per cent., the seams provide "high volatile bituminous coals of fair quality" and thicknesses of 5 ft. and 6 ft. are common. Admirably produced topographical and geological maps on the scale of 1 : 62,500 are provided with the memoir.

The importance of a suitable site for the installation of seismographs is illustrated in a recent number of the Georgetown (U.S.A.) University Publication. Two Wiechert seismographs were placed temporarily at the base of a tower 212 ft. in height, and the rocking of this tower by heavy winds affected the records of the instruments. These and other seismographs were then erected in a heat- and damp-proof

cave excavated beneath the quadrangle. The Publication referred to contains the records of these instruments for the whole of the year 1916, and Press notices of earthquakes which occurred during the same year in various parts of the world. The influence of the war is shown by the fact that all but ten of these earthquakes were of American origin.

THE Department of Mines of the South Australian Government has recently issued its first metallurgical report. The author is Mr. J. D. Connor, the Government metallurgist, who has undertaken a visit to the United States of America with the view of studying the recovery of copper from its ores by leaching and precipitation. His object was to secure such information as might assist in rendering available for realisation the mineral assets of South Australia, and in particular the unworked oxidised copper ores of the northern mining fields. Too much stress cannot be laid on the absolute necessity for exhaustive experimentation before any attempt is made to deal with the problem of leaching copper ores on a large scale. The principle of insisting on properly controlled tests before a working plant is erected is applicable to almost every metallurgical proposition. Mr. Connor's visit was not so successful in its outcome as he had anticipated. Although he travelled more than 10,000 miles, he saw only two leaching plants in actual operation, one of a capacity of 2000 tons a day, and the other an experimental plant of 40 tons per day. He did not visit the great plant at Chuquicamata, in Chile, where 10,000 tons of ore are leached per day. His general conclusion is that the leaching of copper ores is not being carried out in the United States to anything like the extent that might have been anticipated considering the amount of literature on the subject. A great deal of experimental work has been done in the past by very able operators backed by large organisations. To a considerably less extent this work is going on now, but it has been completely put into the background by the recognition of the possibilities of the "flotation" process (see NATURE, March 22). That American metallurgists should have been so long in taking up this process is certainly surprising, but now that they have done so, and particularly after litigation difficulties have been removed, it is likely that great developments will take place. As yet oxidised ores are not susceptible to treatment by flotation processes.

IN view of the movement for the establishment in France of a number of national laboratories at which the scientific problems which arise in the industries may be investigated, *La Nature* has commenced the publication of a series of articles dealing with the laboratories which have been founded in other countries for the same purpose. On account of the prominent position the National Physical Laboratory at Teddington has made for itself in the short time it has been in existence, it has been chosen as the first of the series, and in the issue of *La Nature* for March 10 a well-illustrated article giving an account of the foundation, method of management, and equipment of the laboratory appears.

THE *British Journal Photographic Almanac* for this year has at length appeared. Present circumstances have not only delayed its issue, but reduced its size to little more than the half of what it used to be; still, it is a bulky volume of 780 pages. The maximum number of pages allowed to any one advertiser having been very much reduced, some manufacturers' announcements are a great deal more condensed than heretofore, but the advertisement pages remain a very good guide to the various branches of the trade. The "Epitome of Progress" is curtailed chiefly with regard to kinematography, the literature of which published during the last year is very voluminous. The new British-made developers are included in the tables of formulæ. The section referring to sensitisers and dyes for colour-filters remains very much as before. The editor's article treats in a lucid manner with the elementary principles of chemistry so far as concerns the practice of photography, and this, therefore, is an appropriate time to point out a chemical error that is of many years' standing. The lengthy and useful table of chemical names, symbols, and atomic weights of numerous compounds has the atomic (or molecular) weights given described as "equivalent weights," which, of course, they are not.

THE *Biochemical Journal* for December, 1916, contains an important paper by Mr. H. Ackroyd and Prof. F. G. Hopkins, entitled "Feeding Experiments with Deficiencies in the Amino-acid Supply: Arginine and Histidine as Possible Precursors of Purines." In the authors' experiments young growing rats were fed first on a diet composed of acid-hydrolysed caseinogen, potato-starch, cane-sugar, lard, butter, and ash from equal weights of oats and dog-biscuit, then on the same diet from which the arginine and histidine had been removed, and finally on this second diet plus arginine or histidine, or both. The necessary vitamine supply was given in the form of a protein-free alcoholic extract of fresh-milk solids. In other experiments the tryptophane or the vitamine was absent from the diet. The results show that when both arginine and histidine are removed from the diet there is a rapid loss of body-weight of the rats, and a renewed growth when the missing diamino-acids are restored. Nutritional equilibrium is possible in the absence of one of these protein constituents, but not in the absence of both. The suggestion is made that this is because each of the two diamino-acids can, in metabolism, be converted into the other. If both arginine and histidine are removed from the food, the amount of allantoin excreted is much diminished, but the decrease is very much less when only one diamino-acid is removed. When both are replaced, the excretion returns to the normal. When tryptophane or vitamine is removed from the food there is no decrease in the amount of allantoin excreted, although nutritional failure is then greater than when arginine and histidine are withheld. It is accordingly suggested that these two diamino-acids play a special part in purine metabolism, probably constituting the raw material for the synthesis of the purine ring in the animal body.

THE registrar of the Institute of Chemistry is particularly well situated to appreciate the important part played by chemists in the war, since he has had control of the register of chemists available for Government and other services maintained by the Institute. This fact adds an enhanced interest to the article "Chemists in War" which he contributes to the Proceedings of the Institute for February. The general community is probably at last beginning to know that the *rôle* of the chemist in the manufacture of high explosives is all-important, but it is very doubtful whether it realises even yet that his help is necessary in the production of all metals, cloth, leather, india-rubber, glass, food, pure water, and medicine—in fact, of practically every article of everyday life. Many chemists have been appointed to commissions in the Royal Army Medical Corps, the Army Service Corps, and the Army Ordnance Corps, whilst in order to fight the German with his own weapon, a special force of chemists was enlisted for the preparation and employment of poisonous gas at the front in Flanders. The chemists employed in the

Army have received the recognition both of Lord French and of Sir Douglas Haig. A large number of chemists have been engaged to work in the laboratories and works of Government and controlled establishments making munitions of war. The chemical staffs of Woolwich Arsenal and of the Government Laboratory have been largely increased, whilst university and college laboratories have in many cases become small factories for the preparation of drugs, antiseptics, etc. Finally, and perhaps most important of all, the Government has accepted the guidance of our most able and experienced chemists in the investigation of such problems—become acute by reason of the war—as merit their special attention. At last the chemist seems to be coming into his heritage.

An interesting paper on the subject of sulphur in petroleum oils was read by Dr. F. M. Perkin at a recent meeting of the Institution of Petroleum Technologists. Nearly all naturally occurring petroleum oils contain sulphur, some having only a very small proportion, others large amounts. Oils obtained by the distillation of shales also contain sulphur, the proportion depending partly upon the quantity present in the material distilled, and partly upon the form in which the sulphur exists in that material. The paper illustrates the numerous forms in which sulphur may occur in the oils by reference to the homologous thiophenes, thiophanes, and alkyl sulphides; the probable origin of the sulphur in petroleum is also discussed. Be the origin what it may, as a constituent of petroleum oils sulphur is very objectionable. In petrol it gives rise to a disagreeable exhaust; in lamp-oils it causes an unpleasant odour, decreases the luminosity, and tarnishes domestic ornaments; in oil fuel it vitiates the atmosphere of the stokeholds and corrodes boiler-plates and tubes. Hence the question of desulphurising the oils is one of much importance. We have in the Kimmeridge shales a considerable source of shale oil, but, unfortunately, the sulphur content is very high. If a practicable method of removing the sulphur could be found, the Kimmeridge shale oil would be of immense value to this country. Many attempts have been made, but so far without success. Dr Perkin describes various methods of desulphurising which have been employed or proposed, and also outlines a new process, which consists in the treatment of the oil at high temperatures with gaseous ammonia. In these circumstances sulphur is eliminated from the oil in the form of hydrogen sulphide. At present, however, the process is only in its initial stages, and not much information could be given as to its practical application.

The eighty-third annual report of the Royal Cornwall Polytechnic Society (vol. iii., part ii., 1916), just issued, is of more than local interest, because of the important scientific and industrial research papers included in it. A paper on "The Physical Condition of Cassiterite (Tin Ore) in Cornish Mill Products," by the late Mr. J. J. Beringer, contains a new theory to account for the loss of the tin mineral which present appliances fail to recover. It is explained by a thoughtful introduction by Mr. W. H. Trewartha-James, who collated and revised the author's notes just before he died. This paper attracted wide attention, and nearly all the mine managers in Cornwall were present at the society's meeting at Falmouth in 1915 to discuss the important conclusions. The discussion ultimately resulted in the decision of the Government Department of Scientific and Industrial Research to subsidise and establish a scheme of research in tin and tungsten minerals at the suggestion of the Institution of Mining and Metallurgy in co-operation with the Royal Cornwall Polytechnic Society. Other papers in the report are: "Tin and Tungsten Minerals in the West of England," by the late Mr. J. H. Collins; "The Prospects of Tin in the United States," by Mr. H. Foster Bain, presenting important facts with regard to the international position of the tin industry; "The Development of Mechanical Appliances in China Clay Works," by Mr. J. M. Coon; "Piskies," a Cornish folk-lore study, by the president, Mr. H. Jenner; and a lecture on the fly problem by Mr. F. Balfour Brown. The report can be obtained from the society, or from William Brendon and Sons, Ltd., printers, Plymouth, price 5s.

OUR ASTRONOMICAL COLUMN.

Comet 1917*a* (Mellish).—The discovery of a new comet by Mr. Mellish, on March 20, has been announced by Prof. Strömgren. It was observed at Copenhagen on March 22 in R.A. 2 h. 9 m., decl. 15° 1′ N., and was rated at mag. 7·5. The comet is situated in the constellation Aries, and is consequently only visible for a short time after sunset.

D'Arrest's Periodic Comet.—On the basis of corrected elements for this comet, which has a period of six and a half years and returns to perihelion this year, the following ephemeris has been given by J. Braae (*Ast. Nach.*, 4874):—

1917		R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
March	29	22 41 59	−6 25·3	0·1031	0·3101
April	2	22 56 29	5 34·9	0·1027	0·3092
	6	23 10 52	4 43 8	0·1030	0·3086
	10	25 8	3 52·1	0·1039	0·3084
	14	39 14	3 0·4	0·1054	0·3086
	18	23 53 11	2 8·9	0·1076	0·3088
	22	0 6 58	1 17·9	0·1103	0·3094
	26	20 34	−0 27·8	0·1136	0·3102
	30	33 57	+0 21·2	0·1175	0·3113
May	4	0 47 9	1 8·8	0·1218	0·3125
	8	1 0 9	+1 54·7	0·1266	0·3138

The date of perihelion passage is April 2. During the above period the comet will be about two hours west of the sun.

Bright Meteors in March.—Mr. Denning writes: On March 14 at 10 h. a meteor equal to Jupiter was observed at Totteridge and Stowmarket. It fell over the south-east coast from a height of 71 to 17 miles. On March 15 at 11 h. 30 m. a meteor as bright as Venus was observed by Miss G. Lewis from Droitwich, and by several other persons in various parts of the country. The records of its flight are not, however, in good agreement, though the radiant point was probably in the Lynx, and the position of the object nearly over Cheltenham at its disappearance. On March 19 at 7 h. 32 m., a fine meteor was seen through clouds at Bristol, as it sailed almost vertically down the northern sky. On March 27 at 10 h. 17 m. and 10 h. 43 m. a pair of brilliant meteors were seen by Mrs. Wilson at Totteridge, and by Miss T. E. Gall at Hornsey, N. They were directed from a radiant low in the east near μ Libræ, and pursued nearly horizontal flights at heights of about 54 miles, and velocity 15 miles per sec.

Photographs of Jupiter.—Photographs of the planet Jupiter showing a large amount of interesting detail were obtained during the recent apparition by Mr. J. H. Reynolds with a 28-in. reflector at his observatory near Birmingham (Journ. B.A.A., vol. xxvii., p. 151). The telescope was adapted as a Cassegrain with an equivalent focal length of 55 ft., and the image was further magnified from three to six times by a Barlow lens. At the opposition of 1916, the N. temperate belt, which was absent in 1915, re-appeared with strength and size comparable with that

of the S. temperate belt, and the intervening zone between it and the N. tropical belt was occupied by a remarkable series of bright elliptical formations, usually accompanied by dark condensations on the south preceding side. These elliptical forms appear on all the photographs taken during 1916, and are probably to be interpreted as representing cyclones.

THE INSTITUTION OF NAVAL ARCHITECTS

The spring meetings of the Institution of Naval Architects were held in the rooms of the Royal Society of Arts on March 28 and 29. In the unavoidable absence of the president—the Earl of Durham—the Marquis of Bristol took the chair and delivered an address, in which he referred to the question of the formation of a council for co-ordinating the common interests of the various institutions representing engineering professions. Such a council, in making recommendations, would have the weight of the whole profession behind it.

The Elgin scholarship has been awarded to Mr. R. J. Shepherd, and the annual gold medal to Prof. T. B. Abell for his paper on experiments to determine the resistance of bilge keels to rolling. A premium has been awarded to Mr. A. T. Wall for his paper on some effects of the Bulkhead Committee's report in practice.

Despite the disadvantages under which the institution has been placed owing to so many of its members being engaged on work intimately connected with the war, thirteen papers were read and discussed. The standard of the papers has in no way diminished, and many contain matter of considerable scientific interest.

Mr. D. B. Morison's paper on standardisation as applied to the machinery for cargo-boats is of much interest at the present time, when a strong effort is being made to make good losses due to piratical submarine operations. A specification for such machinery is being discussed now by the North-East Coast Institution, and an appeal was made for joint action by all the institutions connected with shipbuilding. An interesting feature of Mr. Morison's paper is the many references to economic problems. It is futile for capital to expect that labour will consent to any great reduction in wages, and equally hopeless for labour to expect the maintenance of the present high rate of wages without concession on its part. To render it possible to pay high wages in the future and yet maintain our trade, the requisites are (i) a candid acknowledgment by labour of the economic law that good general trade is dependent on maximum production, and (ii) capital must recognise that maximum production entails correspondingly high pay.

Mr. J. Montgomerie contributed a valuable paper giving an account of experiments conducted at the West Ham Technical Institute on stress determination in a flat plate. In these experiments the plates were bolted in a very heavy frame, rectangular in plan, leaving a surface of plate measuring 4 ft. by 2 ft. exposed to water-pressure. The object was to hold the plate round the edges as rigidly as possible. Bach's plates—which constitute the only experimental work on the large scale up to the present—were not held so rigidly at the edges. Crawford's experiments on the same subject were on too small a scale. Mr. Montgomerie has experimented on several plates of various thicknesses; the plate 0·75 in. thick alone is reported upon in the paper, although the experiments on the other plates have been completed.

Measurements of deflection were made at many stations on the plate, and curves plotted showing the cross-sections in directions parallel to the edges. From these curves, by application of graphical methods, the stresses at the stations were determined. Owing to the nature of the graphical methods employed, it was considered desirable that the strains in the plate should be measured directly, and for this purpose a strain-meter was devised by Mr. J. Duncan and used in such a manner as to determine the principal axes of strain at the stations. The principal strains were then measured at each station, and from the knowledge thus obtained, together with the measured values of Young's modulus and Poisson's ratio for the material, the principal stresses were determined and the ellipses of stress drawn for each station. The results by these two methods show very fair agreement.

The resulting diagram is very interesting, and shows the elastic behaviour of the entire plate. It shows that the maximum stress actually occurs at the centre of the plate and not at the frame ends of the short diameter, as has been supposed hitherto. There is no doubt that this fact is due to the elastic movements of the portion of the plate clamped in the frame, which permit the "wall section" to assume slope instead of remaining in the plane of the wall, as is assumed in the usual mathematical theory. The effect of this behaviour is to diminish the bending moment at the plate edges and to increase that at the centre; the stresses, of course, alter correspondingly. Mr. Montgomerie has promised further information regarding the other thinner plates tested, and his contribution must be regarded as a valuable addition to our knowledge of cases of complex stresses.

Mr. Thomas Graham described an apparatus for interpreting stability for the use of shipmasters, whereby the stability of vessels under any ordinary conditions of loading can be shown graphically and easily interpreted. This instrument illustrates three features of stability which are of most practical importance, viz.:—(i) An automatic record of the variation of the righting arm as the ship heels over from the upright to the vanishing angle. (ii) The approximate angle of heel at which the freeboard deck edge becomes awash. (iii) The position of the water-line throughout the range of moderate angles met with in practice. The appliance consists of a pivoted wooden lamina representing a cross-section of the ship, and having a pointer moving over a protractor showing angles of heel. A plumb line is hung from the position on the lamina corresponding to the known centre of gravity of the ship. A brass plate having a curved edge representing the metacentric evolute for the given draught and displacement is attached to the lamina, and another plumb line is arranged to pass over the edge of this evolute and to hang tangentially. The distance between the two plumb lines thus shows to scale the magnitude of the actual righting lever at all angles of heel. An additional feature is an arrangement for indicating the position of the water-line.

Prof. W. E. Dalby read a paper illustrating the inner structure of mild steel, and showing how its strength is correlated with this inner structure. This paper is one of the most readable produced up to date, and contains explanations which can be followed readily by reference to the many micrographs included. Load extension diagrams of all the steels have been obtained by use of the author's well-known apparatus.

Lieut. Walter A. Scoble contributed a paper on the design of pin joints based on ultimate strength. The author gives reasons leading to the conclusion that the maximum load carried is the best criterion for the strength of a pin joint, and describes in detail a method by which the calculations required in designing a joint can be made.

Mr. J. J. King-Salter gave an account of some experiments on the influence of running balance of propellers on the vibration of ships. Since the introduction of turbines in warships, running at a much higher

speed than reciprocating engines, the necessity of seeing that the propellers were suitable not only as regards form, but also as regards their being in proper mechanical balance, has received considerably more attention. Experiments have been carried out in two destroyers and a Town class cruiser built at the Commonwealth Naval Dockyard at Sydney. The paper describes experiments made by rotating the propeller at speed on spring bearings, noting the vibration and removing material from certain parts of the blade and even the boss. From subsequent observations on the ships it was apparent that there was a decided improvement. The problem to be solved is by no means easy, since removal of material from the blades of a propeller has the effect of altering the pitch, and naval architects, as a rule, have very stringent specifications regarding the exactitude of the pitch of a propeller.

Sir George Greenhill contributed a paper on the theory of wave-motion on water. In this paper the author discusses mathematically the trochoidal wave as treated by Rankine. Mr. John H. Macalpine gave particulars of marine applications of reduction gears of the floating-frame type. The success of this type of gear appears to be very marked. The first floating-frame gear was installed at Granite City, Illinois, in 1911; when examined on April 30, 1916, the scraper marks were still visible on the gear teeth. Originally these marks were of imperceptible depth.

Messrs. P. A. Hillhouse and W. H. Riddlesworth presented a paper on launching. This paper contains an account of some interesting experiments made at the Fairfield Shipbuilding Yard. A model of the ship was constructed and arranged in all respects to be a reduced copy. Model ways were constructed and a tank arranged with water at proper tide level. By these means valuable information was obtained regarding the motion of the ship during launching. The authors make an interesting suggestion whereby an accurate record of the complete motion of the actual vessel from start to finish might be obtained by means of the kinematograph. Two machines would be required, one placed near the stern of the vessel when on the slip, and the other somewhat less than the length of the vessel further aft. Both would stand at a convenient distance away from the vessel's side, and would have their axes at right angles to the middle line of the berth. In the field of view of each, two uprights would be placed as near to the vessel's side as possible, and on each upright a vertical scale of feet would be clearly marked in black and white. On the ship's side would be painted a continuous longitudinal white line crossed by short vertical lines numbered in succession from either end. As the vessel moved the cameras would record continuously the movements of the white line in relation to the ship and to the water level and ground ways, and the whole motion could be reconstructed. If, in addition, there could be placed in front of each camera a large clock-face with seconds pointer, the two sets of photographs could be correlated and a record of velocities obtained.

BRITISH FILTER-PAPERS.

AS is well known to laboratory workers, in pre-war days the better kinds of filter-paper used in chemical operations were not produced in this country. They were imported chiefly from Germany and Sweden. In particular, the so-called "ashless" filters, from which most of the mineral matters have been extracted by treatment with hydrochloric and hydrofluoric acids, had made the name of one German firm familiar in probably every chemical laboratory of importance throughout the kingdom. The outbreak of war, however, stopped the supply of German filters, and British paper-makers turned their attention to meeting the demand.

The qualities required in filter-paper depend upon the purpose to which it is to be applied. Thus for certain technical operations, such as the filtration of oils and fruit juices, a soft paper of open texture is desirable. Further, as such paper is often used for filtration under pressure, a high degree of elasticity is required in it to prevent fracture. In analytical work, on the other hand, whilst a paper with open texture which filters rapidly is preferable for flocculent precipitates like ferric hydroxide, a close-texture paper is required for the retention of fine precipitates such as barium sulphate. Moreover, the proportion of mineral matter is important. Compounds of calcium and iron, frequently with a little copper, and sometimes silica and alumina, are the chief mineral impurities found in filter-paper; and for accurate quantitative work the amount of these should be small. Indeed, it should preferably be so small as to be negligible except where a high degree of exactitude is required. In any case, it should be definitely known, and ought always to be stated on the packets of filters by the makers.

The ability to retain fine precipitates, a minimum proportion of ash, and reasonable rapidity of filtration are thus the chief desiderata in the best filters for chemical laboratory purposes. The last alone is sufficient in many technical operations. Discussing this question in the *Analyst* some months ago, Messrs. Bevan and Bacon indicated that for paper required to filter with moderate rapidity the ratio of the volume of the paper to that of its constituent fibres should be about 3·5 to 1. It does, in fact, as a rule vary between the limits 3 and 4·5 to 1. "Pinholes" are sometimes found in paper having this ratio or "bulk" (as the technical term goes); they are attributable to faults in the milling.

Some time ago specimens of the filter-papers now produced in this country were supplied to us by three manufacturing firms, namely, Messrs. W. and R. Balston, Ltd., Maidstone; Messrs. J. Barcham Green and Son, Maidstone; and Messrs. Evans, Adlard and Co., Ltd., Winchcombe. Judging by the reports furnished with certain of the papers, supplemented by tests applied in actual working practice, a number of the samples compare quite well with the foreign filters which they have replaced. It is evident that a serious endeavour is being made to produce filters which will compare favourably in quality with even the best of those hitherto imported, and the efforts appear to have met already with a considerable measure of success. Naturally, it will take time and careful study completely to outvie the foreign articles, which are the result of long specialisation. Uniformity of product is an important point to aim at, so that the user may know that he can rely upon the constancy of the quality. There is no obvious reason why British paper-makers should not, with proper technical advice, compete successfully with foreign manufacturers in this branch of industry, and, in fact, there is good reason to believe that they will do so. In this matter, as in so many others, we ought not to have to revert to the *status quo ante bellum*.

COMPULSORY CONTINUATION CLASSES.

THE final report of the Departmental Committee on Juvenile Education in Relation to Employment after the War has just been issued (Cd. 8512, price 6*d*. net).

The terms of reference of the committee were: To consider what steps should be taken to make

provision for the education and instruction of children and young persons after the war, regard being had particularly to the interests of those (i) who have been abnormally employed during the war; (ii) who cannot immediately find advantageous employment; (iii) who require special training for employment. Among the twenty-three recommendations made by the committee are the following:—

(1) That a uniform elementary school leaving age of fourteen be established by statute for all districts, urban and rural, and that all exemptions, total or partial, from compulsory attendance below that age be abolished.

(2) That steps be taken, by better staffing and other improvements in the upper classes of elementary schools, to ensure the maximum benefit from the last years of school life.

(3) That it be an obligation on the local education authority in each area to provide suitable continuation classes for young persons between the ages of fourteen and eighteen, and to submit to the Board of Education a plan for the organisation of such a system, together with proposals for putting it into effect.

(4) That it be an obligation upon all young persons between fourteen and eighteen years of age to attend such day continuation classes as may be prescribed for them by the local education authority, during a number of hours to be fixed by statute, which should be not less than eight hours a week, for forty weeks in the year, with the exception of: (a) Those who are under efficient full-time instruction in some other manner; (b) those who have completed a satisfactory course in a secondary school recognised as efficient by the Board of Education and are not less than sixteen; (c) those who have passed the matriculation examination of a British university, or an equivalent examination, and are not less than sixteen; (d) those who are under part-time instruction of a kind not regarded as unsuitable by the Board of Education and entailing a substantially greater amount of study in the daytime than the amount to be required by statute.

(5) That all classes at which attendance is compulsory be held between the hours of 8 a.m. and 7 p.m.

(6) That it be an obligation on all employers of young persons under eighteen to give them the necessary facilities for attendance at the statutory continuation classes prescribed for them by the local education authority.

(7) That where there is already a statutory limitation upon the hours of labour, the permitted hours of labour be reduced by the number of those required for the continuation classes

(8) That the curriculum of the continuation classes include general, practical, and technical instruction, and that provision be made for continuous physical training and for medical inspection, and for clinical treatment where necessary, up to the age of eighteen.

(9) That suitable courses of training be established and adequate salaries be provided for teachers of continuation classes.

(10) That the system of continuation classes come normally into operation on an appointed day as early as possible after the end of the war, and that the Board of Education have power to make deferring orders fixing later appointed days within a limited period, where necessary, for the whole or part of the area of any local education authority.

(11) That the State grants in aid of present as well as future expenditure on education be simplified and very substantially increased.

RECENT PROGRESS IN SPECTROSCOPY.[1]

TEN years ago the subject of Prof. Crew's vice-presidential address was "Facts and Theories in Spectroscopy." Since that time some notable discoveries have been made and some remarkable theories have challenged attention. It is my purpose to review a few of the more important experimental results and to discuss the relations of some of them to theories brought before you in two recent vice-presidential addresses on "Atomic Theories of Radiation" and "The Theory of the Nucleus Atom." Inasmuch as it will be necessary to refer to them, I will restate the salient features of the theories which have attracted the most attention.

Planck derived an expression for the spectral energy distribution of black-body radiation from the assumption that the radiation was emitted and absorbed by electric oscillators in definite quanta, each equal to the frequency of the oscillator multiplied by a universal constant, h, the wirkungsquantum. Later he modified this theory so far as absorption is concerned. Einstein and others went farther in assuming that these quanta preserve their identity in their propagation through space, thus reviving a form of corpuscular theory. This extreme view has been generally abandoned, but it has been found impossible to explain away the wirkungsquantum h. It appears in too many relations to be the result of chance. The work of Millikan in particular proves the exact validity of Einstein's relation $Ve=h(\nu-\nu_0)$ in the photoelectric effect, in which Ve is the measure of the emission energy of the electrons, ν the frequency of the incident light, and ν_0 the minimum frequency which will cause emission of electrons. A similar relation appears to hold good in many cases of X-ray and light spectra. It seems probable that this constant depends upon atomic structure only, and affects radiation through space only in so far as emission and absorption are determined by atomic structure.

The theory of the nucleus atom is likewise of fundamental importance in spectroscopy. The work of Rutherford and others leaves no escape from the conclusion that the nucleus of the atom is a concentrated group of positive charges and electrons, with an excess of positive elementary charges approximately equal to half the atomic weight, while the same number of electrons circulate about the nucleus in rings. The spectroscopist must try to fit his theories to these probable facts, but he is met at the outset with apparently insuperable difficulties in accounting for the stability of such atoms and for the manifold complexity of spectra according to accepted electrodynamical laws. Bohr cut the Gordian knot by supposing that the classic laws apply only to conditions of stability, when no energy is radiated, and that radiation attends the transition of an electron from one state of stability to another, the frequency being determined by the relation that h multiplied by the frequency is equal to the difference between the energies of the system in the two stable states. In the case of hydrogen, to which he assigns one radiating electron and one nucleus charge, it is difficult to account for the existence of so many stable states, for the failure to radiate while subject to uniform radial acceleration, and for monochromatic radiation while passing between two positions of stability. Nevertheless, Bohr derived an expression like that of Rydberg which locates accurately not only the Balmer series, but also an infra-red and an ultraviolet series predicted by Ritz and found by Paschen

[1] Address delivered to Section B—Physics—of the American Association for the Advancement of Science at the New York meeting, December, 1916 by the chairman of the Section, Prof. E. P. Lewis.

and by Lyman, respectively. His attempt to apply the same method to helium led to results which are still in dispute, and will be referred to later.

In reviewing recent progress we may begin with that field in which the United States has taken a leading part—that of astrophysics. This domain belongs as much to the physicist as to the astronomer. The heavenly bodies are laboratories on a vast scale, in which nature has provided conditions of temperature, pressure and electrical state which we may never hope to rival on the earth. The spectroscope gives us data from which it may be possible to form some idea of these conditions by comparison with our feeble laboratory imitations of celestial phenomena, and conversely, the latter may aid in the interpretation of terrestrial phenomena.

One of the most fruitful astronomical applications of the spectroscope is to the determination of velocities in the line of sight, by the Doppler-Fizeau principle. A large mass of such data has been collected, from which some important generalisations have been derived. For example, Campbell has determined the velocity and direction of motion of the solar system through space, and has found a remarkable and as yet unexplained relation between the velocities of stars and their apparent age, the redder and presumably older stars and a class of nebulæ having in general the greater velocities. It likewise appears that two immense star streams are crossing each other in the Milky Way. Many spectroscopic binaries have been discovered and their orbits determined, and recently there have been found remarkable displacements and rotations in nebulæ which may throw some light on the nature and destiny of these bodies. The spectroscope has enabled astronomers to undertake the ambitious task of tracing the course of stellar evolution.

The most ingenious and fruitful device for studying the sun is the spectroheliograph, invented by Hale in 1892. With this instrument photographs of the distribution of a given constituent of the solar atmosphere may be obtained by restricting the light falling on the photographic plate to the wave-length of one of the characteristic lines of the element. The configuration of the hydrogen clouds in the neighbourhood of sunspots led Hale to suspect vortical motions in such regions. In 1908 the study of a number of plates, which showed that hydrogen flocculi were actually drawn into these spots from great distances, proved without question that sunspots are cyclonic areas of enormous extent. Thus the long-disputed question as to the nature of sunspots was answered, but this was not all. Vapours which emit or absorb line spectra are ionised, and as the more mobile electrons would diffuse more rapidly to higher levels than the positive ions, Hale inferred that the immense whirls of electrified vapours in the neighbourhood of the spots must cause a radial magnetic field. If such fields are sufficiently intense, the longitudinal Zeeman effect should be produced. As a matter of fact, the spectrum of light from the spots is characteristically different from that of the surrounding photosphere, one of these peculiarities being the doubling of many lines. As Hale anticipated, an examination of the state of polarisation of such lines showed them to be circularly polarised, and the direction indicated that the whirling vapour was negatively electrified. Hale likewise sought for the more minute effects which might be expected from the rotation of the solar atmosphere as a whole. A study of the breadth of spectral lines at different latitudes and the detection of traces of circular polarisation at their edges showed that the sun possesses a magnetic field with polarity corresponding to that of the earth, but of much greater intensity. Although the atmospheric conditions on the earth are very different from those on the sun, it is possible that these investigations may assist us in solving the baffling problem of the earth's magnetism.

One of the most impressive facts revealed by the spectroscope is the substantial identity of constitution of the heavenly bodies. Everywhere we find evidence of the existence of such elements as hydrogen, sodium, calcium, and iron. But we also find an infinitude of differences in the appearance of the lines, which we must attribute to differences of temperature, vapour density, pressure and electrical condition. It is suggestive to find that the spectrum of some stars resembles that of the arc, of others that of the spark. We may hope by comparing the spectra of these bodies with those produced in our laboratories under varied conditions to reach some conclusions regarding their physical state. The Mount Wilson physical laboratory is doing much valuable work of this kind.

In the spectra of the solar corona and of nebulæ and nebulous stars certain lines are found which do not belong to known elements. This need not indicate any fundamental differences between the life-history of such bodies and that of the older stars. Twenty-five years ago Lockyer's views regarding the dissociation of elements in the stars were treated with levity by most physicists and astronomers. To-day such notions are held to be quite rational. The more elementary forms of matter would naturally be of small atomic weight, and hence would diffuse to higher levels than the heavier elements, and might ultimately escape into space. If it were not for the fact that it is held captive in chemical combinations, we should know nothing of hydrogen. Helium first revealed itself to us through its solar lines, and would still be otherwise unknown to us were it not for its continuous production in radioactive processes. The elements giving the spectra of the corona and of the nebulæ are presumably of small atomic weight, and are possibly the units out of which more complex known elements are built, in later stages of development; or they may be, conversely, the results of the disintegration of such elements. It is not impossible that in the future we may detect traces of these elements on the earth or manufacture them by some powerful disintegrative process. Meanwhile, deductions from known relations between frequencies of the spectral lines, their breadth, and the atomic weight of the elements may give us some clue to their atomic weights. Nicholson has succeeded in constructing hypothetical atoms with given nuclear charges and electron ring systems which give with remarkable accuracy the positions of the lines of the corona and nebulæ. Rayleigh showed from kinetic theory and Michelson proved experimentally that at low pressures the width of lines may be entirely due to Doppler displacements, which vary directly as the square root of the absolute temperature and inversely as the square root of the atomic weight. Buisson and Fabry have verified this law and applied it to the study of nebulæ. The width of certain lines, determined from the limit of interference, indicates that the temperature of the Orion nebula is about 15,000 degrees, and that two groups of lines are due to atoms of weights 2·72 and between 1 and 2 respectively. This is a remarkable confirmation of Nicholson's previous conclusion that the emission centres are of atomic weights 2·95 and 1·31.

During the past ten years the boundaries of the known spectrum have been greatly extended in both directions. The difficulties of investigation in the infra-red are very great, but by the methods of reststrahlen and of focal isolation Rubens, working in succession with Nichols, Wood and von Baeyer, has isolated and measured certain regions of great wave-length. The longest wave-length measured is

about 0·3 mm., while the shortest Hertzian waves so far obtained are 2 mm. long. The study of line radiation in this region is even more difficult, but Paschen and his pupil, the American Randall, have succeeded in measuring many lines extending to about 90,000 Ångström units.

In the ultra-violet Lyman has extended the region first made known to us by Schumann to a wave-length of about 600 Ångström units. Beyond this point it is difficult to go, on account of absorption, lack of sensitiveness of the photographic plate, and small reflecting power of speculum metal. Gratings ruled on silicon and photoelectric detectors may enable us to bridge the gap between these waves and the much shorter ones which may be examined with the aid of nature's diffraction gratings, crystals which have made the study of X-ray spectra possible.

Of all the discoveries of recent years, that of the wave nature of the X-rays and of a practical method of examining their spectra is the most remarkable and the most important, for it has revealed to us the most fundamental radiations of the elements and has given us a glimpse into the very heart of the atom. In quick succession Laue and his pupils demonstrated the diffraction effects produced by crystals, the Braggs showed how reflection might be employed to isolate waves of different lengths by a principle similar to that producing colours of thin plates, but of far greater resolving power by reason of the greater number of effective reflecting surfaces, and Moseley photographed many characteristic spectra by an extraordinarily simple method. He found that the principal lines in the spectra of a large number of elements were connected by a remarkably simple relation, namely that the square roots of the frequencies are proportional to the ordinal numbers, which increase by one in passing from one number of a periodic group to the next. When there are anomalies between the atomic weight and the place of an element in a group, this anomaly disappears when the atomic number rather than the atomic weight is considered. This work has been extended by others, notably by Siegbahn and Friman, to include nearly all the known elements between sodium and uranium, inclusive, with the result that all the atomic numbers between hydrogen and uranium are accounted for, with the exception of six gaps. As interpreted by Bohr's theory, the ordinal number which determines the frequency is the excess number of positive elementary charges in the nucleus, and these results are, therefore, in complete harmony with the theory of the nuclear atom developed by Rutherford, van den Broek, Soddy, and others. The comparison of the X-ray spectrum of lead obtained by Siegbahn with the gamma-ray spectrum of radium B obtained by Rutherford and Andrade shows the identity of ten of the principal lines. This strikingly confirms the accepted theory of isotopes, or elements of different atomic weights, which are chemically and spectroscopically alike beause they have the same resultant nuclear charge.

The positions of the principal lines are consistent with Bohr's general formula, but perhaps this relationship is purely formal. But whether or not this theory applies, apparently we cannot dispense with the wirkungsquantum. In addition to the characteristic X-radiation of an element, there is a continuous spectrum, with a sharply defined boundary on the side of shorter wave-lengths. The investigations of Duane, Hull and D. L. Webster have shown that this boundary is accurately defined by Einstein's relation $Ve=h\nu$ for fields up to 110,000 volts. Such a simple law does not hold for the characteristic radiations; but Webster has shown that they do not appear until the voltage somewhat exceeds that demanded by the Einstein relation. The longest X-waves so far discovered by Siegbahn are about 12 Ångström units in length, so that there is not a very great gap between them and the shortest waves discovered by Lyman. The investigation of this region is difficult, but undoubtedly means will be found to attain success. Much also remains to be done in the study of details of X-ray spectra, which contain many weak lines, and possibly bands, which have not so far been carefully examined.

During the past ten years great advance has been made in our knowledge of spectral series. Rydberg, Ritz, Paschen, Fowler and others have shown that a generalised form of the Balmer equation, with Rydberg's universal constant and a few special constants, is capable of wide application. Different combinations of a few constants have been found to give a number of related series, and many new lines so predicted have been found. The common limit and other numerical relationships between different series of the same element indicates that the different emission centres have some dynamic coupling and Rydberg's universal constant indicates a structural element common to all substances. According to Bohr, this quantity is a function of the electronic and atomic mass, the elementary electrical charge, and the wirkungsquantum h, and should slightly increase with increasing atomic weight. As it is commonly assumed that it is an absolute constant, careful measurements may furnish a test of the validity of Bohr's theory.

The relationships of frequency to atomic number found by Moseley recalls that Ramage, Watts, Runge and Precht and Hicks have found linear relationships between the squares of the atomic weights and the frequencies or frequency differences of homologous lines in the spectra of elements of the same group. Ives and Stuhlmann have shown that in some cases the results are improved by substituting atomic numbers for atomic weights, but the relationship is evidently not so simple as in the case of X-ray spectra.

The discovery of the Zeeman effect and the explanation of its simpler forms by Lorentz was the first step toward a rational spectroscopic theory. The later discovered complexities and anomalies, while they may defy mathematical analysis, do not lessen our confidence in the theory, for they are what we might expect as a result of complicated atomic structure. The same intellectual satisfaction does not attend the discovery of the analogous effect of an electric field, because the simplest cases are so complex that they cannot be adequately explained by any theory yet proposed. The possibility of such an effect had long been the subject of speculation, but Stark was the first to realise and attain the necessary conditions for its occurrence. Lo Surdo also discovered it in the neighbourhood of the cathode in capillary tubes. As in the case of the Zeeman effect, the phenomena are different when viewed transversely and parallel to the field. In each case the lines are split into a number of components, the number being different for different lines, even for those belonging to the same series. In the transverse effect the components are plane-polarised in hydrogen and helium, the stronger central lines vibrating at right angles to the field, and the stronger outer components vibrating parallel to the field. A remarkable relation is found for the series lines of hydrogen, helium and lithium. For each the number of principal normal components appears to be equal to the ordinal number of the line in the series. Higher dispersion shows that in the case of hydrogen each component is double. If this rule holds good throughout the series, the last known line, the twenty-eighth, would have fifty-six such components, an equal number polarised at right angles to these, and a

number of weaker components of both kinds—truly a formidably complicated system. In general, the longitudinal components appear to be unpolarised, although Miss Howell has found some anomalies with lithium and calcium. In some cases the components are unsymmetrical both in position and in intensity. Of all the other elements investigated, mercury alone shows a slight broadening. It might be expected that the great nuclear charges of heavy atoms would diminish the effect of an external field. The inverse absorption effect has so far not been observed.

Long before the Stark effect was observed Voigt showed that such results might be expected from quasi-elastic forces in the atom and the stresses produced by the field. Schwarzschild has attempted to explain it by the ordinary laws of electrodynamics, and Warburg, Gehrcke, Garbasso and Bohr by Bohr's theory. Each attempt was successful in some respects, but each failed to account fully for all the components, their displacements and their state of polarisation, and all the theories assign the same number of components to each line of a series, whereas one of the most significant features is the progressive difference in number of components, displacements and relative intensities in passing from one line to another. Stark not only rejects them all, but is led by his study of the phenomenon to abandon finally the quantum and light-cell theories, because he considers that he has proved that the greatest possible energy which an electron can acquire in its orbit falls far short of one energy quantum. Moreover, he argues that it seems impossible to explain the phenomenon in terms of Bohr's one electron. He concludes that a number of electrons must take part in the emission of a single line, each having the same frequency under ordinary conditions or in a magnetic field, but different frequencies when displaced unsymmetrically in an electric field. It is difficult, however, to understand why hydrogen has only one detachable electron if Stark's view is correct.

It has already been mentioned that at low pressures the width of lines may be ascribed entirely to the Doppler effect. The great broadening at higher pressures has never been explained, but it has been assumed that damping, collisions and rotations all play a part. Stark suggests that it may be largely due to atomic electric fields, which may exercise a large influence when the atoms are crowded together. It seems significant that the broadening increases with the ordinal number of a line in a series, is often unsymmetrical, and diminishes with increasing atomic weight in most cases, quite in harmony with the effects of an electric field. Nicholson and Merton have found that the broadening of hydrogen lines is in quantitative agreement with Stark's suggestion.

With changes in vapour density, pressure, temperature or the mode of excitation lines belonging to one series may weaken or disappear, other lines may be strengthened, and new lines may appear. We must assume that different groups of lines are due to different emission centres. These differences must depend upon the size of the particles, or upon the number and arrangement of electrons. Any theory must take account of the molecular or atomic state or the electrical charge of the emission centres. In some cases we have rather definite information on these points.

A number of elements emit band spectra under some conditions, line spectra under others. One conclusion which seems to be well established is that band spectra are emitted by molecules, line spectra by atoms. Universally, we find that compounds give band spectra, never line spectra. If a compound is dissociated by the discharge the line spectrum of one or both constituents appears. Elements give band spectra with feeble excitation, line spectra when the discharge is so intense as to cause dissociation. It seems reasonable to infer that the band spectra of elements is likewise associated with the molecular condition. In the case of monatomic elements which give both band and line spectra electrical conditions must determine the nature of the radiation.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The war has brought women students into prominence in Germany. They form a third of the actual number of students in residence at the twenty-two universities of the Empire, and one-tenth of the total number of registered students. During the winter of 1916–17 there were more women than men at several German universities, *e.g.* Marburg and Münster; in Bonn, Frankfurt, Munich, Heidelberg, and Jena the women formed half the students, while they were in a minority at Strassburg, Leipzig, Breslau, and Giessen. Altogether, there were 5757 women undergraduates at the German universities during the last term, distributed as follows:—Literature and history, 2789; mathematics and science, 1036; medicine, 1479; dentistry, 64; economics and agriculture, 225; law, 116; Protestant theology, 18; and pharmacy, 30.

The committee appointed to consider arrangements for post-graduate teaching in the Calcutta University has, we learn from the *Pioneer Mail*, presented a report dealing exhaustively with that subject. In summing up the recommendations the committee states that the proposals, in the main, amount to the acceptance of two fundamental principles: (*a*) an intimate association and co-operation between the college and the university staffs is imperative in the interest of all concerned and of the development of higher teaching; (*b*) it is necessary to constitute a suitable organisation within which the teachers will be enabled by discussion among themselves efficiently to conduct the teaching and examination of graduates. Beyond this, says the report, the committee has been unable to go and has refrained from commenting on the wider problems which confront the University.

SOCIETIES AND ACADEMIES.

London.

Royal Society. March 22.—Sir J. J. Thomson, president, in the chair.—**J. C. Mottram** and Dr. **S. Russ**: Observations and experiments on the susceptibility and immunity of rats towards Jensen's rat sarcoma. Observations have been made upon the modes of growth of Jensen's rat sarcoma following inoculation. There is a gradual transition from those cases in which the tumours spontaneously disappear to those in which they grow in a uniformly progressive manner. The experimental production of the immune condition can be brought about in several ways. Animals made refractory to the growth of the tumour have been given various doses of X-rays; the effect of such irradiation upon the blood was to cause a marked reduction in the number of lymphocytes. Over suitable conditions of exposure it has been possible to destroy the immune condition and thus convert refractory into tumour-bearing animals. There is a tendency for the immune condition to be restored. Histological and other evidence is brought forward which indicates that the failure of sarcoma cells to grow in an immune animal is due to an active resistance thereto on the part of the host.—**S. Pickering**: Problems bearing on residual affinity. It has been ascertained that the

alkali metals, like the other metals previously examined, form metallo compounds isomeric with normal salts, and that, therefore, these metals may assume a valency higher than that usually exhibited by them. A class of compounds intermediate between the metallo and normal salts also exists. These are termed metallato compounds. The possibility of most metals, other than carbon and hydrogen, assuming a valency value higher than that usually exhibited by them is shown to explain (i) the constancy in the heat of substitution of CH_3 for H as contrasted with want of constancy in the case of the substitution of OH or Cl for H; (ii) the fact that the heat of neutralisation of organic acids is lower than that of inorganic acids, and exhibits certain distinctive features when only partially effected; (iii) that all true acids must contain a doubly linked oxygen atom, and that the apparent exceptions to the constancy of the heat of neutralisation are due to the acid not being a true acid; (iv) that the so-called normal salts of the alkali metals with organic acids are strongly alkaline, and that those with inorganic acids are feebly so; (v) that the usual method of titration of an acid by an alkali, as well as the precipitation of the acid or base by usual methods, fails in the presence of an organic acid; (vi) that the actual value of the heat of neutralisation constant can be explained.—Prof. E. **Wilson** and Prof. J. W. **Nicholson**: Residual magnetism in relation to magnetic shielding. (i) The paper contains a further contribution to the study of the problems presented by the necessity for constructing a magnetic shield capable of reducing the earth's field to an order as low as 0·001 C.G.S. unit in a large space. The main problem not treated in earlier papers is that of residual magnetism in the various shells of the shield, and this problem is discussed in connection with exhaustive experiments in the present paper. (ii) It is found that the ordinary process of demagnetisation of a mass of iron fails to be completely effective if, during the operation of the current which is diminished by steps and continually reversed, a constant magnetic field such as that of the earth is present at the same time. This phenomenon has escaped notice hitherto, probably on account of the smallness of the earth's field, but it becomes prominent in experimental work involving the measurement of fields so small as that specified in (i). (iii) This effect of the steady magnetic field is shown to be associated with a reversal of the residual effects of hysteresis in iron when tested in the earth's field by currents lying within a certain range in which they approximately annul the field. (iv) It has been found possible to ensure complete removal of irregular polarisation or previous magnetic history of the shells, provided that during the preliminary demagnetisation of the shells the earth's steady field on them is annulled by a steady current of suitable amount enclosing the whole shield. (v) The well-known fact that iron, polarised by a large force, and afterwards tested for permeability at a lower force, shows diminished permeability at the lower force, gives, in combination with these results, an interpretation of the increase of permeability manifested by iron when tested within a magnetic shield.—Dr. S. **Chapman**: The solar and lunar diurnal variations of terrestrial magnetism.

Zoological Society, March 20.—Dr. A. Smith Woodward, vice-president, in the chair.—E. P. **Allis**, Jr.: The prechordal portion of the chondrocranium of *Chimaera colliei*.—D. M. S. **Watson**: A sketch-classification of the pre-Jurassic Tetrapod vertebrates. The classification introduced in this paper is founded on a detailed consideration of all parts of the skeleton of such old amphibia and reptiles as are at all well known. In previous papers the author has analysed the features presented by many of these forms, distinguishing between those which are common to all early reptiles and those which are restricted to definite stocks, the latter being divided into those dependent on "adaptive radiation" and the more fundamental characters, especially those of the brain-case and ear, which are not to be correlated with any special mode of life. These non-adaptive characters, which appear in typical forms even in early members of a stock, serve for the ordinal and superordinal grouping, adaptive changes being used for groups of lower order and the gradual loss of primitive structures giving horizontal dividing lines.

Dublin.

Royal Dublin Society, March 27.—Prof. Hugh Ryan in the chair.—Prof. W. **Brown**: The change in Young's modulus of nickel with magnetic fields. The change is smaller for alternating than for direct longitudinal magnetic fields. With transverse magnetic fields, both direct and alternating, the Young's modulus first increases, then decreases; and the magnetic field in which the maximum value occurs is smaller the greater the constant load on the nickel wire.

Paris.

Academy of Sciences, February 26.—M. A. d'Arsonval in the chair.—E. **Ariès**: The entropy of perfect gases at the absolute zero of temperature. The entropy at the absolute temperature is not $-\infty$, but is in the indeterminate form of two infinite quantities of opposite signs. It is shown that for a gram-molecule of a solid, the increase in the entropy, when vaporising entirely at a low temperature as a perfect gas, tends towards the gas constant R, as the temperature approaches the absolute zero.—P. **Vuillemin**: *Eurotium amstelodami*, supposed parasite of man.—Henri Lecomte was elected a member of the section of botany, in the place of the late Ed. Prillieux.—G. **Julia**: Binary forms of any degree.—P. **Gaubert**: A new property of sphærolites.—L. **Gentil**: The Upper Marine Miocene of West Algeria.—M. **Stuart-Menteath**: The interior basins of the Pyrenees.—M. **Miège**: New attempts at the disinfection of the soil. The antiseptics used included toluene, carbon bisulphide, hydrogen peroxide, lysol, formol, potassium permanganate, copper sulphate, sulphur, bleaching powder, and wood charcoal. In large-scale experiments, toluene and carbon bisulphide proved the most efficacious, as regards both increased yield and the health of the plants.—M. **Weinberg** and P. **Séguin**: Study on gas gangrene. *B. oedematiens* and anti-*oedematiens* serum.

March 5.—M. A. d'Arsonval in the chair.—A. **Lacroix**: The phonolitic rocks of Auvergne: A delicate case of interpretation of the chemical composition of felspathoid rocks.—G. **Bigourdan**: Some seventeenth-century observatories in the provinces. Historical details are given of La Flèche, Le Maurier, Loudun, and Arles.—G. **Giraud**: Hyper-fuchsian functions and systems of total differential equations.—E. **Cotton**: Characteristic number and radius of convergence.—R. de Montessus de **Ballore**: Left algebraic curves.—E. **Belot**: The possible *rôle* of volcanoes in the production of meteorites.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1916. Observations were made on sixty-four days during the quarter, and the results are given in tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A. **Berget**: A differential refractometer for measuring the salinity of sea-water. The two liquids to be compared are placed in a rectangular box separated into two parts by a diagonal glass partition. An image of a slit, after passage through this double prism, is focussed in a microscope, and the

displacement of the image measured by a micrometer eyepiece. Densities can be indirectly determined by this refractometer to the fifth decimal figure with great rapidity.—L. **Abonnenc**: The laws of flow of liquids by drops in cylindrical tubes. Vaillant has shown that when a liquid falls in drops from the orifice of a cylindrical tube the weight of a drop is a parabolic function of the frequency of fall. An extension of these experiments to tubes of less than 2 mm. external diameter is given.—P. **Gaubert**: The rotatory power of liquid crystals.—A. **Guilliermond**: Vital observations of the chondriome of the flower of the tulip.—C. **Vincent**: The forms of phosphorus in Breton granitic soils. The amount of phosphorus found in these soils will be underestimated if the method of extraction by strong mineral acids is used in the analysis. The organic phosphorus present in the humus may amount to 50 per cent. of the total phosphorus, and this explains the effects of liming these soils. From these results a rational method of manuring is deduced.—M. **Herlant**: The variations of the volume of the nucleus of the egg rendered active by butyric acid.—J. **Effront**: Achrodextrinase. Certain species of *B. mesentericus*, cultivated in a nitrogenous medium, secrete a diastase liquefying starch. The hydrolysis of starch by this ferment was studied in comparative experiments with malt extract, ptyalin, and pancreatic amylase. The behaviour of the mesenteric amylase was distinctive, and the name achrodextrinase is proposed for it. Some practical applications in the textile industry and in the laundry are suggested.—M. **Marage**: Arterial pressure in cases of deafness caused by shell shock. Eighty-two per cent. of the cases examined showed arterial pressure above the normal, and insomnia generally accompanied the hypertension. The pains in the head, usual in these cases, do not appear to be connected with the arterial pressure. The best treatment is d'Arsonvalisation.—M. **Lautier**: The treatment of cases of war-deafness. The Marage method is easy to apply, generally useful, and never harmful. Its general employment in these cases is strongly recommended.—M. **Rappin**: Antituberculous vaccination.

BOOKS RECEIVED.

British Wild Flowers: Their Haunts and Associations. By W. Graveson. Pp. xv+320+plates l. (London: Headley Bros.) 7s. 6d. net.

The Tutorial Chemistry. By Prof. G. H. Bailey. Part ii., Metals and Physical Chemistry. Third edition. Pp. viii+460. (London: University Tutorial Press, Ltd.) 4s. 6d.

Météorologie du Brésil. By C. M. Delgado de Carvalho. Pp. xix+525. (London: John Bale, Ltd.) 25s. net.

Chemistry for Beginners. By C. T. Kingzett. Pp. vi+106. (London: Baillière, Tindall, and Cox.) 2s. 6d. net.

Contributions to Embryology. Vol. iv. Nos. 10, 11, 12, 13. Pp. 106+plates iv. (Washington: Carnegie Institution.)

Carnegie Institution of Washington. Year book, No. 15. Pp. xii+404. (Washington: Carnegie Institution.)

Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species inhabiting Tahiti. By Prof. H. E. Crampton. Pp. 311+34 plates. (Washington: Carnegie Institution.)

X Rays. By Dr G. W. C. Kaye. Second edition, with illustrations. Pp. xxi+285. (London: Longmans and Co.) 9s. net.

Electrical Laboratory Course. By Dr. M. Maclean. Pp. 120. (London: Blackie and Son, Ltd.) 2s. net.

A Short System of Qualitative Analysis. By Dr. R. M. Caven. Pp. viii+162. (London: Blackie and Son, Ltd.) 2s.

The Chemists' Year Book. Edited by F. W. Atack, assisted by L. Whinyates. 2 vols. Pp. 1030 (London and Manchester: Sherratt and Hughes.)

Studies in Insect Life, and other Essays. By Dr. A. E. Shipley. Pp. ix+338. (London: T. Fisher Unwin, Ltd.) 10s. 6d. net

An Introduction to a Biology, and other Papers. By A. D. Darbishire. Pp. xviii+291. (London: Cassell and Co., Ltd.) 7s. 6d. net.

The Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches. By Prof. G. Lunge. Fourth edition. Supplement to Vol. i., Sulphuric and Nitric Acid. Pp. xii+347. (London: Gurney and Jackson.) 15s. net.

Bill's School and Mine: a Collection of Essays on Education. By W. S. Franklin. Second edition. Pp. vii+102. (South Bethlehem, Pa.: Franklin, McNutt, and Charles.) 1 dollar.

Geology: Physical and Historical. By Prof. H. F. Cleland. Pp. 718. (New York: American Book Co.) 3.50 dollars.

DIARY OF SOCIETIES.

THURSDAY, April 12.

Institution of Electrical Engineers, at 6.—Wayleaves: C. Vernier.

Optical Society, at 8.—Light Filters for Eye Protection: L. C Martin—Accuracy of Observation and Precision in Measurement: Dr G. A Carse.—Some Methods of Analysing Lens Systems: S. D. Chalmers.—A Simple Proof of the Expression for the Focal Power of a Thick Lens C. Cochrane.

FRIDAY, April 13.

Royal Astronomical Society, at 5.

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THURSDAY, APRIL 12, 1917.

TWENTIETH-CENTURY CHEMISTRY.

Chemical Discovery and Invention in the Twentieth Century. By Sir William A. Tilden. Pp. xvi + 487. (London: George Routledge and Sons, Ltd., n.d.) Price 7s. 6d. net.

THIS book is an attempt to make clear to the general reader the nature of the work of the chemist. That ubiquitous person known as the "man in the street" probably considers that he already knows, at least in general terms, what that work is. The business of a chemist, he would probably say, is to vend tooth-brushes, sponges, photographic appliances, perfumes, and other "leading lines," drugs and poisons, and to make up prescriptions. He might add that the chemist is a person who seeks to combine the pretensions of a profession with the instincts of a shopkeeper.

The object of Sir William Tilden's book is to show that there are chemists and chemists. What our friend the "man in the street" regards as a chemist is, strictly speaking, an apothecary or a pharmacist, and his business nowadays has little or nothing to do with that of the chemist properly so called. There was a time when the two occupations had much in common. We owe to the labours of old-time apothecaries, especially in Scandinavia, France, and Germany, many notable advances in chemical knowledge, but leaders in chemical science in this country were, until a couple of generations ago, for the most part cultured persons of leisure and position, like Boyle, Hales, and Cavendish, or connected with teaching, like Black, Priestley, and Dalton. If the records of chemical discovery are searched, it will be found that the apothecaries in this country, unlike their fellows on the Continent, have contributed comparatively little to the common stock of chemical knowledge.

It is not our present purpose to indicate the reasons for their comparative neglect of a science which constitutes the very basis of the business of pharmacy, or to show why so little advantage is taken by apothecaries, as a class, of the opportunity it affords them for chemical inquiry. One reason, perhaps, may be found in the very different professional position which the apothecary holds in this country as compared with his Continental brother. But, be this as it may, our immediate point is to insist that our apothecaries have no moral claim to the title of chemist—a title, by the way, never assumed by their Continental brethren, in spite of their superior professional status.

But, although this confusion in the public mind as to the true vocation of the chemist is practically widespread, passing events have served somewhat to enlighten it. The newspapers have taught it that a chemist is a person concerned also with high explosives, noxious gases, dyes and certain drugs which the *soi-disant* chemist is unable to prepare. The "man in the street" had begun to recognise, even before the advent of Sir William Tilden's book, that there are chemists and chemists—chemists whose sole concern is, or should be, with pills, potions, and plasters; and chemists who have merely a vicarious interest in these things, and then only as members of a suffering humanity. This growing recognition of the divergent aims of chemists is meanwhile somewhat unsettling; it is confusion worse confounded. The simplest way to end it would be to amend the Pharmacy Act of 1868, or take some other steps to induce the druggists and pharmacists to drop their assumption of the title of chemist.

Pending such a consummation, we commend the book under review to the general attention of the public. A perusal of its interesting pages will serve to dispel any lingering doubts as to the proper function of a chemist. The author, in a short but suggestive introductory chapter, rapidly traces the change in the public attitude towards science, and in particular chemistry, as an instrument of education. In spite of checks and hindrances due to conservatism and the opposition of vested interests, the record as a whole makes cheerful reading. Steady progress has been made during the past three or four decades, and the movement is progressing at an accelerated rate, largely through the impetus given to it by the crisis through which this country is passing. It is this circumstance which renders the publication of Sir William Tilden's book so opportune. The lesson it seeks to convey is of the highest national importance. The author's greatest difficulty is how best to convey it. The theme is lofty and inspiring, but the material is vast and complicated, and it has required no small degree of skill and judgment to present it in an orderly and systematic manner, not overcharged with technicalities, and yet free from the ambiguities and loose statements of so-called popular writing. In this respect we think the author has been successful. There are, of course, certain sections which the lay reader who has lost the student-habit may have some little difficulty in grappling with. Questions of chemical constitution and representations of structural formulæ are, of course, beyond the range of even a well-educated man of to-day. Nevertheless, the author makes no assumption of previous knowledge on the part of his reader, but, with the skill of an experienced expositor, gradually builds up a presentation that with a little patient application becomes perfectly intelligible.

The main body of the work is divided into four parts. Part i. deals with chemical laboratories and the work done in them. The laboratories are classified as laboratories for general teaching and laboratories for special purposes. As types of the first class the author enumerates all the more important laboratories at home and abroad, and selects for special description the chemical laboratories of the Imperial College of Science and

Technology at South Kensington, the Royal College of Science for Ireland, the Universities of Harvard, Illinois, and of Sydney, Australia, and gives photographs of their respective elevations and internal arrangements. As types of laboratories for special purposes he describes, with illustrations, those of the Brewing School of the University of Birmingham, of the Manchester Municipal School of Technology, and of the Berlin Technical High School. A full account is given of the appointments and work of the Government Laboratory in Clement's Inn Passage, with numerous illustrations of the special apparatus employed there, as well as a digest of one of the annual reports of the Chief Chemist as illustrating the great variety of chemical work now needed by the Government. This section concludes with a short account of certain instruments and apparatus, with particular reference to the most recent appliances and developments.

Part ii., comprising ten chapters, extending in all over 125 pages, deals with modern chemical discoveries and theories. A short sketch of the history of chemistry and of the development of its principles occupies about a dozen pages. This is necessarily highly condensed—a mere *aperçu* done with the lightest possible touch. But no significant feature is left unnoticed, although some of the most momentous of new departures are dismissed in a dozen lines. The exigencies of his subject—chemical discovery and invention in the twentieth century—together with limitations of space, have, no doubt, imposed what at first sight seems a certain want of proportion in the treatment of the subject-matter. The lay reader who desires to realise what is the work of the chemist is really as much concerned with the broad fundamental truths upon which the science rests as he is with electrons and isotopes. But Sir William Tilden presumably has had to conform to the title imposed upon him by the circumstance of a companion volume under a somewhat similar title, and what his reader may lose in chap. iv. he gains abundantly in the rest of this particular series. In some eight or nine chapters he is treated to a full and clear description of those discoveries which have already made this epoch one of the most remarkable—perhaps *the* most remarkable up to now—in the history of science. The chapters on electric discharge in gases, on the chemical elements, on the discovery and properties of radium, and on the genesis and transmutations of the elements together deal with facts and theories which have shaken the very foundations of the science, and of which the outcome is not yet. The whole story has been put together in an admirable manner, and constitutes one of the most fascinating sections of the work.

Part iii. deals with the utilitarian aspects of chemistry, particularly with some of the more interesting or more important of its modern applications. The mass of material to be dealt with is necessarily very large, and in spite of the severest condensation, this section is the longest in the book. It ranges over such diverse subjects as the modern uses of hydrogen, oxygen, and nitrogen, the luminosity of flames, the incandescent-mantle industry, petrol, coal-tar, synthetic dyes and drugs, perfumes, cellulose, rubber, and explosives. This section constitutes very attractive reading. It is excellently illustrated with well-chosen photographs, and has been brought up to date as regards processes and statistical information. Within the limits of 150 pages no more illuminating or instructive account of the trend of modern chemical application could be given. It is as full of meat as an egg.

The last section of the book is devoted to a comparatively short account of modern progress in organic chemistry, and considering what modern organic chemistry has become, there is probably no section which has cost the author more trouble and thought. Of course, there are whole sections of this branch of chemistry which make no appeal to a general reader. Its problems are for the most part purely academic, and are not capable of being stated in terms intelligible to the lay mind. Sir William Tilden has, therefore, wisely confined himself to certain special sections, some of which, like that of sugar, might equally have found a place in the preceding part. Still, the subject enables a short account to be given of the chemistry of sugars in general, and of the mutual relations and constitution of the members of the several groups. Other chapters are on the proteins, enzymes, and natural colours, in which, considering the restricted space, a sound and accurate statement of present-day knowledge is given.

We congratulate the author on the production of a work as useful as it is accurate and interesting. The book is admirably got up and excellently illustrated, and constitutes a worthy and timely addition to popular chemical literature.

BRITISH PLANTS AND BOTANICAL TERMS.

(1) *Illustrations of the British Flora: a Series of Wood Engravings, with Dissections, of British Plants.* Drawn by W. H. Fitch, with additions by W. G. Smith. Fourth (revised) edition. Pp. xvi+338. (London: L. Reeve and Co., Ltd., 1916.) Price 9*s*. net.

(2) *A Glossary of Botanic Terms, with their Derivation and Accent.* By Benjamin D. Jackson. Third edition. Pp. xii+427. (London: Duckworth and Co., 1916.) Price 7*s*. 6*d*. net.

(1) THE figures prepared by W. H. Fitch for the original illustrated edition of Bentham's "Handbook of the British Flora" have become one of the traditions of British botany. Remarkably compact, and for their size admirably depicting the important features in habit and characters of flower and fruit, they have proved one of the most widely used aids to the identification of British plants. Mr. W. G. Smith,

who is responsible for the additional drawings necessary to bring the book more into line with modern requirements, is well known for his power of depicting the salient features of a plant-subject. The new edition is of a similar handy size and form to the last, but some new features, to which reference is made in the preface, have been added with the object of increasing its usefulness. These comprise the reproduction from the "Handbook" of an "Arrangement of Natural Orders," with some of their distinguishing characteristics, and the addition of a few synonyms and the English name below the scientific name by which each plant is known in the "Handbook." In the matter of arrangement and nomenclature the "Illustrations" must naturally follow the companion "Handbook," which is recognised as the most conservative of the British "Floras." But it is to be regretted that an opportunity has not been found for re-arranging in both "Handbook" and "Illustrations" the system of classification so as to bring it more into accordance with modern views. The Conifers still appear as the last family of Dicotyledons, and the catkin-bearing families are all grouped under the one family Amentaceæ. The English names are still, in many cases, those invented by Bentham—that is, merely translations of the Latin name, and in no sense popular names. There is evidence of want of care in proof-reading in such names as *Anacharis Alismastrum, Spiranthes Romazoriana*, and *Orchis muscula*; the first is quite a new name, and it will puzzle the editor of a future supplement to the "Kew Index" to know to whom it is to be credited, as the book has no author; the names of Messrs. Fitch and W. G. Smith appear alone on the title-page, and the preface is anonymous.

(2) A new edition of Dr. Jackson's "Glossary of Botanic Terms" is always welcome, if only for the opportunity which it gives a reviewer of expressing on behalf of botanists generally their gratitude for one of the most used and useful works of reference. Apart from the tremendous labour involved in the gathering and arrangement of the material, there is the ever-present difficulty as to what terms are to be included and what omitted. The rise and development of a new branch of the science, such as œcology (which Dr. Jackson, following botanical custom rather than orthography, cross-references to ecology), with its almost startling fecundity in new terms, must be viewed with consternation by the compiler of a glossary. Dr. Jackson has steered a safe course between unduly increasing the size of his book and omitting useful references, and there are few terms, apart from those which are self-explanatory, which the botanist will not find indexed and explained in the new edition of the "Glossary." Botanists will be surprised to hear of the extent to which their terminology has grown; the total numbers included by Dr. Jackson amount to nearly 21,000, though many of these are archaic or have never been generally accepted. Almost any page opened at random will reveal strange or little-known terms, *e.g.* "drusy," a term used by one author to express the appearance of the stigma of *Orobanche caryophyllea*, while on the same page we notice four variants for the familiar "drip-tip" of a leaf. "Ennobling" is an old term for inarching; and "entrance," the outer aperture of a stoma, seems unnecessary; as also does "equilateral," equal-sided—one wonders what other meaning this could have even in botany.

Botanists can help Dr. Jackson in two ways: by informing him of any presumed omission from his "Glossary," and by refraining from making new terms except when necessary. There are a useful appendix on signs and abbreviations, another on the use of the terms "right" and "left," and a bibliography, the items in which are arranged chronologically.

OUR BOOKSHELF.

Bengal, Bihar and Orissa, Sikkim. By L. S. S. O'Malley. (*Provincial Geographies of India.*) Pp. xii+317. (Cambridge: At the University Press, 1917.) Price 6*s*. net.

THE present volume is a valuable addition to this useful series, already represented by Mr. Thurston's account of Madras, and that of the Panjab by Sir J. Douie. Special difficulties prevented the earlier issue of Mr. O'Malley's volume. While the book was under preparation the re-shuffling of boundary-lines in 1912 resulted in the obliteration of the artificial partition set up in 1905; Assam was again made independent, while Eastern and Western Bengal were constituted into a governorship, and Bihar and Orissa became a new province. The general reader, with his attention concentrated on Calcutta and Dacca, thinks of Bengal as a land of rice and jute swamps built up by the action of the rivers Ganges and Brahmaputra, occupied by an effeminate race best known to us in Macaulay's classical description. But all Bengal, as now constituted, is not confined to the Sundarbans and the eastern districts. There are a hilly region on the south-east and the great Himalayan chain to the north, while Bihar, with its stalwart peasantry and its wide tracts of rice, maize, wheat, and barley, presents a startling contrast to the conditions of the Delta.

Of this varied region, with its physical differences, its many races and castes and religions, its history, archæology, social and industrial life, Mr. O'Malley gives a valuable account, illustrated by a fine series of photographs. The book adds new life and interest to the crude facts and statistics embedded in provincial gazetteers, census and administrative reports. The universal craving for litigation, the adaptiveness of the Bengali, the intensity of his religious life shown in the growth of new sects, the Mongoloid strain appearing in the east and combined with that of the Aryan to form the people of Bihar, the old-fashioned religious and social institutions of Orissa—of all

these things Mr. O'Malley gives a readable description.

The book is sure to be largely used in English and Indian schools and should be in the hands of every young officer posted to India, while, studied by all who are interested in the progress of the Empire, it should remove many current misapprehensions and bring to the notice of home readers some idea of the weighty and complex problems which the Civil Service, patiently and without advertisement, has hitherto solved with conspicuous success.

High-speed Internal-combustion Engines. By A. W. Judge. Pp. ix+350. (London: Whittaker and Co., 1916.) Price 15*s*. net.

THIS book opens with a general discussion on the thermodynamic principles involved in the properties of gases and mixtures of gases, followed by a chapter descriptive of experiments on rates of combustion, etc., in the engine cylinder. Working cycles and the conditions occurring in actual engines are then treated; this section has a useful collection of experimental data on the losses due to different parts of the engine mechanism and to the friction of gases flowing along passages. A section on pressures and temperatures follows, and has many references to well-known experiments. Chap. v. deals with indicators and indicator diagrams, and has useful descriptions of modern high-speed indicators. The remaining two chapters deal with the mechanics of the engine and with balancing.

The volume is intended to form a companion to one upon the design of high-speed internal-combustion engines, and possibly this explains the absence of drawings descriptive of typical engines. We should hesitate to recommend the book to students until the opportunity arises of examining the proposed companion volume. The practical engineer will not much appreciate the almost total absence of reference to brake-horse-powers, and to the special methods of measuring them which have to be adopted in high-speed motors. There are several minor blemishes. Thus on p. 1 various heat units are defined, including the British thermal unit, and omitting the lb.-deg.-cent. heat unit; J is given as 778 foot-pounds. But the Centigrade system is employed throughout almost the whole of the book. On p. 26 the symbols M and *m* conflict; M appears in the text and *m* in the equation. On p. 69 we read the loose statement that "1 cubic foot of petrol would require for complete combustion . . . 45·41 cub. feet of air"; and on the same page: "The volume of the exhaust product . . . is 14·75 lbs." On p. 186 work is measured in "feet-lbs.," and elsewhere in "foot-lbs."

There are no exercises for the student to attempt for himself, but there are a few worked-out examples in the text. The book, however, contains a collection of matter which cannot fail to be of service to anyone studying problems connected with the changes occurring inside the cylinder of internal-combustion engines.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Very Penetrating Radiation in the Atmosphere.

IT is noteworthy that English physicists have taken very little interest in the progress which has been made during the last ten years in atmospheric electricity. This is the more remarkable seeing that some of the problems are problems in pure physics, and there is little doubt that they give evidence of phenomena of fundamental importance. To take one or two examples. There can now be no doubt that the earth is giving off a constant stream of negative electricity which passes at least into the upper atmosphere, and probably into cosmical space. Are we justified in treating this result of innumerable observations in all parts of the world as something which will be explained in due time by the old laws of physics, or should we not recognise the possibility that we have here indications of a new property of matter? The earth is a huge insulated mass of matter moving unrestrained under cosmical forces, and therefore may very well reveal a relationship between electricity and the motion of matter to which laboratory experiments could give no clue. This phenomenon is well worth the consideration of the mathematical physicists who are at present throwing all our preconceived ideas of electricity, mass, motion, and gravity into the melting-pot.

Then, again, it is now no longer possible to treat ball lightning as a figment of the imagination caused by the bewilderment due to a near lightning flash. What are these balls of light which travel and react according to no laws of physics at present known?

The results of Vegard's and Störmer's work on the aurora are probably too new to have attracted wide-spread notice, but here we have indications of true radio-active radiation penetrating our atmosphere and producing the same apparent results as if the atmosphere were being bombarded from outside by the α radiation which is at present under investigation in our laboratories.

The object of this note is to direct attention to another phenomenon of atmospheric electricity which is of first-rate physical importance.

Until quite recently the most penetrating radiation capable of ionising gases of which we have knowledge is the γ radiation emitted by radio-active substances. Balloon ascents, however, made in Germany just before the outbreak of war have given almost incontestable proof of a radiation entering the atmosphere from above which has ten times the penetrating power of the hardest radiation sent out from radio-active substances. The method of experiment is to carry up in a balloon a metal box of 3 mm. thick brass coated on the inside with zinc and hermetically sealed. The ionisation within the box is tested at each height by means of a central electrode connected to a Wulf electroscope. It is found that the ionisation within such a box decreases at first after leaving the ground and then returns to its original value at about 1500 metres altitude, after which it increases rapidly to the greatest height reached. The most perfect set of observations was made by Kolhörster in June, 1914; the most perfect in the sense that his apparatus had had all the defects removed which previous ascents had revealed, and the greatest height of any ascent was reached. The results are shown in the following table, in which q is the number of pairs of ions generated

(cm.$^{-3}$ sec.$^{-1}$) in excess of those generated in the same box on the ground:—

Height km.	0	1	2	3	4	5	6	7	8	9
q	0	−1·5	1·2	4·3	9·3	17·2	28·7	44·2	61·3	80·4

The decrease in the first kilometre is due to the cutting off of the penetrating radiation from the radio-active contents of the ground by the lower layers of the atmosphere. The great increase in the ionisation from 2 km. to 9 km. is clearly shown.

The war has naturally put an end to further observations in balloons, but not to the search for the origin of this amazing radiation.

In a paper published in the Elster and Geitel *Festschrift*, E. v. Schweidler discusses several possible sources of the radiation, only to reject them all. He first calculates the absorption coefficient of the new radiation, assuming that it is penetrating vertically downwards through the atmosphere, and finds $\mu=7{\cdot}46\times10^{-6}$ cm.$^{-1}$ and μ D$=5{\cdot}77\times10^{-3}$ cm.^{2} gram (the corresponding values for γ radiation from radium being given by Rutherford as $6{\cdot}0\times10^{-5}$ cm.$^{-1}$ and $4{\cdot}6\times10^{-2}$ cm.^{2}/gram respectively). Applying these values to the observations, he finds that on the confines of the atmosphere 535 ions (cm.$^{-3}$ sec.$^{-1}$) would be generated in air at standard density. Assuming, then, that the radiation is similar to that sent out by radio-active substances, he calculates that if all the new radiation came from the sun the latter would have to possess a specific activity 170 times as great as that of pure uranium. This he considers to be a quite impossible value.

Schweidler then considers the possibility of the radiation being due to a radio-active gas in the atmosphere, and shows that if the gas obeys Dalton's law, the rate of increase of q with height would be entirely out of agreement with the observed values.

The only hypothesis considered by Schweidler which is not entirely out of agreement with the observations is that cosmical space is filled with a radio-active gas. The calculation shows that, strange as it may seem, the radiation would be independent of the density of the gas, which would only need to have a specific activity 1/1200 of that of uranium to provide the observed ionisation. Needless to state, Schweidler does not favour this latter explanation.

In the *Meteorologische Zeitschrift* for April, 1916, Linke attempts to solve the same problem. He shows that the observations fit in very well with the ionisation which would be produced by a layer of radio-active substance spread uniformly throughout the atmosphere at a height of 20 km. In this case the rays would not penetrate only vertically downwards, but in all directions. This alters the coefficient of absorption from $\mu=7{\cdot}46\times10^{-6}$ cm.$^{-1}$, as calculated by Kolhörster, to $4{\cdot}6\times10^{-6}$, as calculated by Linke.

Linke concludes that there is a layer of cosmical dust in the stratosphere, which is strongly radio-active, and supports it by the following considerations:—

(*a*) The presence of dust in the stratosphere is clearly shown by several optical effects—for example, twilight phenomena and Bishop's rings.

(*b*) Dust which is present in the stratosphere cannot fall into the troposphere except with great difficulty, owing to the temperature inversion, which is a well-known trap for dust.

(*c*) There was a considerable increase of this dust after the earth had passed through the comet's tail in May, 1910.

(*d*) On this occasion Thomson, in America, observed a sudden increase in the penetrating radiation measured near the ground.

Many more observations are necessary before Linke's hypothesis can be accepted, so it is no use considering it in further detail. For physicists, however, the most interesting fact is that these observations leave little doubt of the existence of a new extremely penetrating radiation, which increases as one ascends in the atmosphere.

G. C. SIMPSON.

Airplanes and Atmospheric Gustiness.

In a recent discussion of the action of an airplane encountering gusts, it is stated that a velocity of about six metres per second may be regarded as a mild gust. Making use of an exponential equation and starting from a condition of still air, increasing to a certain intensity, the value of the exponent is taken as determining the sharpness of the gust. With a value of 1, the gust reaches nearly its maximum value in one second, which would be a decidedly sharp gust.

It is evident from the discussion that data for the natural conditions are meagre; in fact, it seems plain that the engineers have entirely under-estimated the velocities likely to be met with in the free air at low altitudes. And gusts do not as a rule begin from a still condition. Moreover, since the flow of the air may be upward, downward, inclined, or on the level, straight or rotary and super-imposed on steady or intermittent general motion, it will be difficult to express in a general formula the condition of flow in a gust; and possibly no two gusts will be alike.

The problem of the stability of an airplane in a gusty atmosphere belongs without doubt to the aeronautical engineer; but there is another problem, that of systematically recording the general character of the air flow with regard to gustiness, which belongs to the aerographer; and it will be readily conceded that this latter problem is now one of some moment. The question is then, How shall gustiness be recorded in the various observatories of the world?

We are attempting at Blue Hill to record each day the number of hours during which aviation is considered safe and unsafe. Our method is doubtless crude, for we use the wind velocities indicated on an anemo-kinemograph, counting as safe those hours during which the average velocity does not exceed 10 m./s., and there is no variation greater than 50 per cent. in five minutes. For example, the records of March 2 and 5 (not reproduced here) illustrate days on which respectively there were 24 and 0 hours suitable for aviation. Incidentally we have been able with another instrument to obtain records showing a variability of 50 per cent. in three seconds; also velocities as high as 60 metres per second; and one true gust in which the total air flow was 370 metres in ten seconds, of which 300 metres occurred in five seconds.

Since we have no International Committee—and let it be said, not in bitterness, but sadness, that it is quite unlikely that representatives of certain nations will be welcomed at any international conference for years to come—there is no way now open to reach an agreement unless the British Meteorological Office will be willing to formulate a definition. Under its progressive director it has become the leading and representative Service, and one the methods of which will be generally accepted.

This particular feature of the weather has not heretofore received much notice, other than the recording of days on which gales occurred; but it is evident now that a more detailed record of the condition known as gustiness must be kept.

Perhaps some of the readers of NATURE can offer suggestions?

ALEXANDER MCADIE.

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THE BEDROCK OF EDUCATIONAL PROGRESS.

THE final Report of the Departmental Committee on Juvenile Education in Relation to Employment after the War, a summary of the recommendations of which appeared in our issue of last week, is a welcome indication of the great change which within the last few years, and notably during the course of the present disastrous war, has come over the mind of the nation in respect of the importance and necessity of increased facilities for education for all classes of the people and the need for a more intelligent and generous estimation of its requirements.

The committee, in entering upon the inquiry, set before itself a high ideal, realising, as the report shows, the great work of reconstruction which the war has imposed upon the nation in many spheres of its activities—social, industrial, and commercial—in the successful accomplishment of which it boldly asserts that "education, with its stimulus and discipline, must be our stand-by." The committee has taken full advantage of the terms of reference to review the conditions under which elementary education is administered in England and Wales, its range, quality, and purpose, especially in the later years of school life, and to lay bare in the report its shortcomings, no less than the grievous waste of the public resources arising from the ineffective preparation of the great mass of the children of the nation for the duties and responsibilities of life and for a satisfactory livelihood, due to the fact that so many of them are allowed to leave school at an untimely age and that no proper provision is made for the continuance of their education on entering into employment.

The war, by the shutting down of commerce with the Central Powers, has revealed to all classes of the community the vast extent to which we were dependent upon them, and especially upon Germany, for the supply of many highly valuable manufactured products, essential to our well-being, and the fruit solely of the applications of scientific discovery: that she held the "key" to certain of our important industries, such, for example, as those of cotton and woollen textiles, which largely depended for their successful marketing upon the dyes and finishes manufactured by German chemical firms. Hence the grave uneasiness which has of late possessed the minds of many of our leaders as to the state of our education, and as to the results of the large and growing expenditure upon it since the Act of 1870, and now amounting, imperially and locally, to considerably more than thirty millions sterling annually.

It is recognised, and it is a highly commendable feature in the report, that elementary education is the base of any effective educational organisation, and that the superstructure of secondary and university education rests of necessity upon it, so far as the means of selection of the best brains of the mass of the nation for the opportunity of advanced training is concerned. The first demand must therefore necessarily be that the course of elementary education shall be continued without any exemption whatsoever for every child up to the age of fourteen at least. The report shows a leakage in full-time attendance at the elementary school of at least 33 per cent. between twelve and thirteen, and thirteen and fourteen years, at least in the period before the war, whilst for the years beyond and up to the age of eighteen the number of young persons outside all vital educational influences reached the astounding number of 2,200,000, or 81·5 per cent. of the total number of juveniles at these ages. This vast number of young people are to be found neither in day nor in evening schools, and to them must be added the large number of half-timers who, chiefly in the textile districts, are receiving a scanty education, under "the present detestable system of half-time exemptions," between the ages of twelve and thirteen.

With this mass of meagrely educated and ineffectively trained young people physically, mentally, and morally, how is it possible to maintain the position of this nation, with its enormous imperial responsibilities, in face of the social, industrial, and commercial competition of the better instructed and trained nations of the Continent, whose recognition of the potentialities of science and the assiduity and the complete preparation with which they have pursued it have enabled the greatest of them, namely, Germany, to become our most formidable rival? Despite the warnings so strikingly set forth in the report of the Royal Commission on Technical Instruction of 1882–84, and of all the efforts which ensued thereon to establish throughout the kingdom technical schools and classes, only a mere fraction of the industrial population has been reached, and because of the inadequate preparation of the large majority of the students who availed themselves of the facilities offered, which were chiefly in the evening, at the close of the day's work, only a comparative few reaped the full benefit of the provision made.

The truth is that we began at the wrong end, and we now realise in some measure the serious character of our error. We failed to perceive that no satisfactory technical instruction can be given except upon a sound basis of general, including scientific, training, continued throughout the full period of pre-adolescent life, and that such training for those capable of receiving it—and they are a considerable percentage of the general mass—shall be further continued for whole-time pupils in suitably equipped and staffed secondary schools, in preparation for the highest specialised instruction and training available in our universities and in the highest type of technological institutions.

For those who must perforce—and they will be the great majority of those attending the elementary schools—enter the ranks of bread-winners on leaving school at fourteen, the report makes a strong plea for provision for continued education for at least eight hours per week, taken from the ordinary working hours and continued for ten months during each year until the age of eighteen is reached. The course of education to

be pursued in these compulsory classes would have reference to preparation for the duties of life, to the right and profitable use of leisure, to instruction in the principles and practice of the occupation into which the young person had entered, and to the care and preservation of bodily health and vigour. To achieve this aim is a national duty of tremendous—of paramount—importance, and, having regard to the vast depletion of our young virile life by the operations of the fierce struggle in which we are engaged, of stern, unyielding necessity, no matter how great the cost, if the future of the nation is to be assured as one of the great civilising and freedom-inspiring forces of mankind. The task of the nation is enormous. It can only be accomplished by a spirit of stern self-sacrifice.

Readers of Nature will not need to be reminded that the findings of this—it is to be hoped, epoch-making—report are consistent with its constant advocacy through many years of the policy of raising the school age, and of requiring regular attendance until the compulsory period of elementary-school training is completed, of due provision in the curriculum for satisfactory training in the facts and principles of science, and of continued compulsory education until eighteen years of age is reached of all young people entering employment at fourteen years of age It is also not out of place to remark that so long ago as 1914, before the advent of the war, the Education and Technical Education Committees of the British Science Guild had prepared a report embodying the main points of the report now under review, and this has since been presented to the Prime Minister's Reconstruction Committee for consideration in connection with schemes of educational reconstruction. The Departmental Committee on Juvenile Education has had the advantage of interviewing witnesses representative of many varied industries, including both employers and employed, together with persons representing the opinions of various educational bodies, and has found, speaking generally, a practical unanimity of opinion in the reforms set forth in the report; it is satisfactory also to find that the report and its recommendations are signed by all the members of the committee. It is to be hoped that the principal recommendations may quickly be given legislative effect.

SCIENTIFIC ASPECTS OF GLASSHOUSE CULTIVATION.[1]

The valley of the River Lea is the seat of some of the most intensive cultivation in the British Isles. The traveller along the Great Eastern Railway line to Cambridge, which traverses this district, begins to see great numbers of glasshouses soon after leaving Enfield, and still more near Enfield Lock, Waltham Cross, and Cheshunt. It is estimated that in this district there are no fewer than 1000 acres occupied by glasshouses, each acre representing a capital of approximately 1000*l.* The chief crops grown are cucumbers and tomatoes, but peaches, grapes, roses, palms, and other plants are also produced. The growers, as might be expected, are extraordinarily skilful: one sends peaches to New York in the proper season at fancy prices; another has even sent palms to Africa; but the great bulk of the produce is grown for the English consumer, and is put on the market at such prices as are within the reach of all.

As might be expected, glasshouse cultivation presents special features marking it off sharply from outdoor work. The temperature and water supply, perhaps the commonest limiting factors on good farms, are under almost complete control, and can therefore be eliminated as limiting factors; but the light supply is often an important factor, while questions of manuring, the adjustment of temperature, and water supply are of enormous technical importance and great scientific interest. In addition, the special conditions lead to some remarkable soil relationships.

Some of these problems were first studied three or four years ago at the Rothamsted Experimental Station, but it soon became clear that the only proper way of dealing with them was to found an experimental station *ad hoc* and to place it in the centre of the district. This was done, the money being found partly by the growers and the county councils, and partly by the Development Commission. The second annual report of the new station is now issued.

It is pointed out in the report that the investigations at the Experimental and Research Station must not follow too closely the lines adopted at the agricultural experiment stations, but must differ from them in taking more account of the qualitative factors which might affect the fruiting, and in recognising light, temperature, and water as factors influencing the growth and habit of the plants. For convenience of investigation the plant-growth is divided into three stages: the early stage, as seedlings and in small pots; the later stages in large pots or borders; and the fruiting stage. This division is justified not only on technical, but also on scientific, grounds.

In the first stage—the seedling stage—probably the most important feature is the type of growth. Growers recognise a "hard" growth and a "soft" sappy growth, the latter being commonly considered of less value for fruit production. The conditions under which each can be got are well known to the grower, but it is very desirable that they should be better characterised than they are at present, and that the relationship between habit and conditions of growth should be studied. The habit of growth owes its importance to the two circumstances that "soft" growth appears to be more susceptible to disease than "hard" growth, and that under certain conditions it is less conducive to fruiting. There are certain discrepancies in the observations so far, arising from the variations in the type of "softness," and these are being studied.

[1] Experimental and Research Station, Nursery and Market Garden Industries Development Society, Turner's Hill, Cheshunt, Herts. Second Annual Report, 1916.

In the later growing and fruiting stages the influence of fertilisers is under investigation, and also the effect of light, temperature, humidity, and other physiological factors. None of the artificial fertilisers produced any notable effect on the tomato crop; the withholding of phosphates caused some depression, but the withholding of nitrogen and potash had little, if any, effect. It must be remembered that the soil is virgin soil, and the results seem to be on a par with the old antagonism between vegetative growth and fruiting. Mr. Spencer Pickering obtained very similar results at Woburn in his manurial experiments with fruit trees and bushes. The result is contrary to the usual experience, and indicates that a marked distinction must be made between virgin soils and soils that have been in use for some time. The reason for the distinction, however, is not clear.

In the case of cucumbers, phosphates in some circumstances actually depressed the crop, as has been noted elsewhere with cotton and sugar-cane. The determining factor in the case of cucumbers under the conditions of the experiment was the temperature, and the experiments show in a striking way how easy it is for the leaves to become overheated in a glasshouse—a phenomenon already discussed by Francis Darwin. The cooler part of the cucumber-house gave in the first year 25, and last year 9, per cent. more fruit than the warmer part. Proper appliances have been installed for the study of this important problem, and the results will be awaited with much interest. E. J. R.

THE NEW FOOD ORDERS.

THE reduction of the available supply of certain articles of diet, especially of meat, flour, sugar, and potatoes, has had the effect of changing to some extent the point of view with regard to economy in diet. While until recently economy in all things was desirable, it has now become necessary to exercise, in addition, special economy in the case of the four things mentioned above. This is due partly to deficiency in means of transport, but, in the case of potatoes, chiefly to bad crops. It must also be remembered that the large proportion of the population serving in the Army or Navy require more than they had in their previous occupations. For these reasons, it has been recommended by some that those who are well-to-do should endeavour to utilise the more costly articles of food, leaving a greater supply of the less costly, but restricted, articles for those who cannot afford the former. With regard to the Army rations, there is some reason to suppose that the allowance of 16 oz. of meat per day is unnecessarily large, at all events for men in the trenches; perhaps it may be the cause of certain diseases which are apt to occur, such as "trench nephritis." This affection seems to have some relation to diet. The meat allowance might, with advantage, and probably with appreciation by the men, be exchanged for an equal energy-value in carbohydrate.

The new arrangement of rationing by bulk, as applied to restaurants, is undoubtedly an advance. As the present writer has pointed out in another place, the old system of limiting the number of courses led to an undesirable increase in the consumption of meat, as compared with other foods. The present allowance of 12 oz. of meat per day gives about 70 grams of protein, in addition to that in bread and other articles—a perfectly adequate supply. It is, however, not quite clear why households should be allowed only about 6 oz. per head. In some cases, no doubt, the smaller consumption by children compensates. But it must always be kept in mind that children require more protein in proportion to their weight than adults, since they are forming new body-tissues, and it is only up to a certain age that children require absolutely less protein than adults. It would probably be correct to say that quite half the total number of households consist of persons requiring the protein ration of adults. Of course, meat is not the only source of protein; oatmeal especially is an excellent source, and, at present, the necessary energy-value can be made up with this, at the same time as the increase in protein.

With regard to the materials to be added to wheat-flour, would it not be better to limit them to those not readily used by themselves, such as barley and rye? Beans, especially, seem to the writer an undesirable constituent of bread. If oatmeal, for example, is to be used in large quantities for mixing with wheat-flour, is it not probable that the price will rise considerably?

The new Order with respect to hoarding of food is rather difficult to understand. Presumably, it is not intended to prevent the purchase of fairly large amounts at a time, provided that these amounts are made to last as long as if bought in small parcels; nor to prevent the storage of sugar for the purpose of making jam by the householder in the autumn. W. M. BAYLISS.

A MINISTRY OF HEALTH.

WITH the terrible wastage of the lives of the best of the nation's manhood in the European conflict, and with a birth-rate the lowest on record, if the country is to recover after the termination of the war and to maintain its place among the nations as a great and thriving industrial Power, it will be necessary for us to conserve to the utmost those lives which we possess and those which we may expect to be born to us. While it may not be practicable at present to anticipate a definite increase in the birth-rate, though it is to be hoped there will before long be a change for the better, it is possible to do much to reduce disability and loss of life from preventable disease. The campaign against venereal disease, the crusade against tuberculosis, the care now being taken of munition and other workers, and the medical consultations at infant welfare

centres and at school clinics all aim at this and are valuable aids towards its consummation.

The most serious item of loss of life is, and always has been, infant and child mortality. For the years 1911-1914, 575,078 children died under the age of five years in England and Wales. It is true that infant and child mortality has declined during the last few years, but, even so, we are losing 100,000 lives or more annually, a large proportion of which could undoubtedly be saved to stock the country in the future. A broad and comprehensive scheme of national health service would accomplish much, and this is a problem to which the best energies of the Government should be directed without delay.

There is reason to believe that the Bill dealing with health questions which it is the intention of Lord Rhondda, the President of the Local Government Board, to introduce, will provide for the creation of a Ministry of Health, in which the supervision of many of the public health and medical services of the country will be concentrated. At present the national health is dealt with by several Government Departments—it is stated, by as many as *fourteen!* Thus, the general public health is administered by the Local Government Board, the health of workers by the Home Office, the health of school children by the Board of Education, the health of ships by the Board of Trade; and the Board of Agriculture, the National Insurance Committee, and other Departments share in various ways. Such a multiplicity of authorities naturally leads to much overlapping, want of co-ordination, and waste.

The establishment of a Ministry of Health, with a Minister of Cabinet rank in charge of it, which would bring under its ægis the whole of the health service and administration of the country, would be a measure of the highest importance at the present time. Wisely conceived and wisely administered, such a Ministry would be welcomed by the medical profession and by health workers generally, the public would gain by increased efficiency and diminished waste, and the national health would be placed on a surer foundation of control than is at present the case.

NOTES.

WE are informed that the South-Eastern Union of Scientific Societies will hold its twenty-second annual congress in the rooms of the Linnean Society, Burlington House, from Wednesday, June 6, to Saturday, June 9, under the presidency of Dr. W. Martin. Arrangements will be facilitated if those proposing to join the congress will communicate with the hon. treasurer, Mr. R. Adkin, 4 Lingards Road, Lewisham, S.E. The Wednesday evening will be devoted to the president's address, and on the Thursday evening the attendance of the congress at the "Hooker lecture" by Prof. F. O. Bower will be invited by the Linnean Society. The union may be congratulated on maintaining its accustomed course at a time when the claims of science are being brought prominently before the public mind.

WE learn from *Science* that the Academy of Natural Sciences of Philadelphia has, on the recommendation of the council and the special committee on the award, voted the gold Hayden memorial geological medal to Prof. W. M. Davis, emeritus professor of geology in Harvard University, in recognition of his distinguished work in the science of geology. The medal, says *Science*, is awarded every third year "for the best publication, exploration, discovery, or research in the sciences of geology and palæontology, or in such particular branches thereof as may be designated." The award as first defined in 1888 took the form of an annual bronze medal and the balance of the income of the fund. The deed of gift was modified in 1900 so as to provide for a gold medal every third year.

DR. J. O. HESSE, director of the Associated Quinine Factories of Zimmer and Co., died at Feuerbach, near Stuttgart, on February 10, in his eighty-second year. Dr. Hesse devoted almost the whole of his scientific career to the extraction and examination of the active constituents of drugs, particularly of cinchona bark, coca leaves, and opium, and was for many years the leading authority on the chemistry of quinine and other cinchona alkaloids. He isolated physostigmine from Calabar beans, cotoin, paracotoin, and other principles from coto and paracoto barks, ditaine from dita bark, and also the active principles from a number of other drugs. Many of his researches were published in the Journal of the Pharmaceutical Society, of which he was elected honorary member in 1879. The value of his original investigations gained for him in 1891 the Hanbury gold medal, the highest honour that the Pharmaceutical Society can bestow.

THE death is announced of Mr. Arthur Brooker, joint-author of Slingo and Brooker's "Electrical Engineering" and of other works. From the *Electrician* we learn that Mr. Brooker joined the telegraph department of the Post Office Service in 1878. In 1889 he became an instructor in the Telegraphists' School of Science in mathematics and laboratory practice, and the following year he was made chief instructor. He was also on the staff of the People's Palace and the Currie School of Engineering as instructor in electrical engineering. His scientific attainments procured for him rapid promotion in the Post Office Service. He was largely responsible for the development of the present testing branch. It was his association in the production of Slingo and Brooker's "Electrical Engineering" in 1890 which brought his name before the public. After the publication of the book the authors entered into journalism, and contributed largely to the pages of the *Electrical Review*. In 1898 Brooker severed his connection with the Post Office, and became works manager of the Peel works of the General Electric Co., where he spent seven years in organising the factory and devoting himself to the manufacture of telegraph and telephone apparatus. In 1906 he joined the British Insulated and Helsby Cables, Ltd., and on the formation of the Automatic Telephone Manufacturing Co. in 1912 he became its general manager, a position he retained until shortly before his death.

THE March number of the *Scientific Monthly* contains a series of articles by well-known American authorities on the question of the metric system of weights and measures. During the last sixteen years the movement for the compulsory adoption of the metric system in the United States has made considerable progress, thanks, in great measure, to the stimulus given by the Bureau of Standards at Washington. The enormous quantity of war material at present being manufactured to metric sizes in America is rendering the workmen as familiar with grams

and centimetres as they are with the pound and foot. It is felt in many quarters that the present time affords an unusual opportunity for making metric weights and measures the official system of the United States. The allegation of the opponents of the system that its general introduction would render obsolete and useless large quantities of machinery and machine tools is being vigorously combated, and it is being made clear to manufacturers that no ordinary machines, such as lathes, drills, shapers, etc., would have to be changed. The same tools would continue to make the same things, but the numerical values of the sizes made would be altered. Much attention has been given to the question whether the expense and inconvenience necessarily incident to the exclusive use of the new system would be too costly, and it is generally conceded that these would be far outweighed by the national and international advantages accruing from the change. It is not proposed that a sudden transition from one system to the other should be sanctioned by Congress, but that ample time for preparation should be allowed. In this way price lists, catalogues, and sizes could be tabulated in advance in both systems, side by side, so that the old numerical values could gradually be dropped.

At the end of July last year, at the instance of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, a meeting of representatives of some of the larger firms engaged in the various branches of the cotton trade and others interested in textile research was called by the Lord Mayor of Manchester to consider the possibility of establishing a scheme for the scientific investigation of the various problems presented by the cotton-using industries, and it was agreed that there is great need for research bearing on the cultivation and manufacture of cotton, and in the dyeing, printing, bleaching, and other finishing processes. It was also thought that efforts should be made to increase and to improve the system of textile education. A provisional committee was afterwards appointed, and this, in due course, was constituted a committee of the Advisory Council of the recently formed Government Department of Scientific and Industrial Research. This committee is largely representative of the various interests concerned. Its function is to formulate a preliminary scheme of a comprehensive character and to report to the Advisory Council, and then to lay before the trade, for its consideration, definite proposals for the establishment of a research association, eligible for recognition by the Government Department, and consequently for monetary grants from the National Exchequer. The committee has to consider the place for research in each branch of the cotton industry, whether in the cultivation of cotton, in spinning, doubling, manufacturing, knitting, lace-making, bleaching, dyeing, printing, finishing, or in the technology of cellulose. It has also to ascertain what facilities now exist for the education of boys entering any of these branches, and what opportunities are likely to be offered by the trade for the employment of highly trained men. It will also formulate a scheme both for an institute to undertake research work in collaboration, so far as practicable, with existing bodies and for an association of firms and individuals willing to make donations and subscribe regularly for a period of years to promote research and improve technical training Any suggestions relating to the researches to be undertaken, or to any other matters coming within the scope of the proposed association, will be welcomed by the committee, and should be sent to the secretary, Provisional Committee on Cotton Research, 108 Deansgate, Manchester.

In the *Archives of Radiology and Electrotherapy* for March (No. 200) Mr. Hector Colwell gives a second instalment on the history of electrotherapy, in which the contributions of Priestley, Jallabert, Galvani, Volta, Aldini, Duchenne, and Marat are described. It is of interest that Marat, the French revolutionary, was a practitioner of electrotherapy. Articles on methods of jaw radiography and on abscess in bone are also included in this interesting number.

A second report upon investigations in the United Kingdom of dysentery cases received from the eastern Mediterranean has been issued by the Medical Research Committee. In this report (No. 2) Drs. Rajchman and Western discuss the findings in 878 cases of bacillary enteritis. Serological evidence of bacillary dysentery was obtained in 34·7 per cent. of the cases examined, of paratyphoid infection in 18·3 per cent., of mixed dysenteric and paratyphoid infections in 10·1 per cent., and of pure amœbic infection in 6·2 per cent. In every case of mixed bacterial infection, dysentery bacilli were the originally infecting virus, and a considerable number of purely bacillary cases of dysentery were detected. While not wishing to minimise in any way the amœbic factor, Drs. Rajchman and Western hold that the Mediterranean infection was essentially a mixed one.

The Journal of the South African Ornithologists' Union for December, 1916, has just reached us. In his observations on the birds of the district of Humansdorp, Cape Province, Mr. B. A. Masterman remarks that Kolb's vulture "has entirely disappeared from that area, not one having been recorded for the last fifteen years," where formerly it used to breed regularly. According to the farmers, this bird was exterminated from having feasted on the flesh of cattle which died of rinderpest during the great outbreak of that disease. The late Capt. Selous, it may be remembered, commented on the absence of vultures of this species from the battlefields in Rhodesia during the Matabele campaign, and attributed it to the same cause. In the same issue the Rev. R. Godfrey has some interesting notes on the summer migration of 1915–16 as observed in the eastern districts of the Cape Province.

A most admirable "Guide to the British Freshwater Fishes," by Mr. C. T. Regan, has just been issued by the trustees of the British Museum of Natural History. In the case of each species described the author gives its distribution not only in our home waters, but also outside the area of these islands. An added interest and value are given to his pages in that, as occasion offers, he provides evidence, from the distribution of our fish fauna of to-day, of a remote connection between our river systems and those of the Continent. His account of the Salmonidæ and of the various hybrid forms which occur so frequently among the Cyprinidæ will be especially welcome. An immense amount of information has been crowded into a very small space, yet nowhere has the reader cause to complain of a lack of interest or lucidity. Finally, the book is most profusely illustrated.

The science of economic aviculture has probably reached a higher standard in the United States than in any other part of the world. This work is carried on by the Department of Agriculture, which, for years past, has spared no pains to enact laws and formulate schemes for the conservation of bird-life, whether for purely economic ends or for æsthetic reasons. As a consequence, it has now available a mass of evidence as to the status and value of

every species within its realms. The latest evidence of its enlightened policy takes the form of a bulletin—No. 465—on the propagation of wild-duck foods. The haunts and food values of no fewer than nineteen groups of plants, comprising sixty species, are here described, together with instructions as to stocking water in need of bait for these valuable birds. The characteristics of wild rice, wild celery, pondweeds, arrow-heads, chufa, wild millet, and water-lilies are all carefully set forth, and this information is accompanied by carefully collected data as to their attractiveness in regard to particular species of wild ducks. Had we followed its lead years ago our own Board of Agriculture would now be able to speak with authority when called on to sift the value of the crudely formed opinions of local agricultural chambers as to the usefulness or otherwise of our native birds in relation to our food supply. The matter is of vital importance, and the clamour for legislation is sometimes insistent. This war has done much for us already; perhaps it may yet bring into being a bureau of ornithology, such as is to be found now in many Continental States, as well as in America.

THE new series of the *Agricultural Journal of India* which is inaugurated with vol. xii., part i. (January, 1917), contains several new features which should add to its value and interest. Selected short articles on a variety of subjects are included for the general reader, in addition to the original articles, which still remain the chief feature. A list of new books is also now added. Of the original articles a communication by Mr. and Mrs. Howard on leguminous crops in desert agriculture is of special interest.

BULLETIN No. 65 of the Agricultural Research Institute, Pusa, contains an account by J. N. Sen of experiments on the assimilation of nutrient materials by the rice plant at various stages of growth. Determinations were made of the nitrogen, phosphoric acid, and potash in the roots, stems, leaves, and ears of samples of a uniform crop taken at six successive stages of growth. The results form an interesting series, and lead to general conclusions which are in close accord with those obtained elsewhere with rice and other cereals grown under widely different conditions. It is of interest to note that no evidence was obtained of any return of phosphoric acid and potash to the soil, such as has been deduced from earlier German experiments.

IN Egyptian agriculture a very important *rôle* is played by the *berseem* crop (*Trifolium alexandrinum*), which covers nearly one-third of the cultivated area of Lower Egypt. The success with which it is grown in the low salt country in the extreme north of Egypt has suggested its use in similar country in India, and experiments have been in progress there on the Sukker and Mirpur Khas Government farms during the past ten years. A summary of the more recent results is given by G. S. Henderson in Bulletin No. 66 of the Agricultural Research Institute, Pusa. The results are uniformly favourable, and it would appear that the special merits of this crop as a cold-weather leguminous fodder crop that will grow in an alkali soil are likely to make it of the greatest value for wide tracts of land in the Government of Bombay and elsewhere in India.

THE Bulletin (No. 193) on calf-feeding experiments issued by Messrs. O. F. Hunziker and R. E. Caldwell, of the Purdue University Agricultural Experiment Station, is essentially technical in character, but contains a feature of general interest in the excellent methods adopted for securing photographic records of the progress in growth of the animals. In each case the animal was photographed on a narrow raised platform with a background divided into six-inch squares. A black or white background was used according to the colour of the calf. Difficulties might be expected in inducing the animals to take up a satisfactory position with relation to the background, but the photographs with which the bulletin is profusely illustrated indicate that these difficulties have been satisfactorily overcome, and the results certainly furnish the feeder with a much better index in regard to the condition of the animal than tabulated figures alone could give.

THE Geological Survey of Scotland, in the development of its national work, has published the first of a series of memoirs on "The Economic Geology of the Central Coalfield of Scotland" (1916, price 4*s*. 6*d*.). The district dealt with extends from Glasgow eastward to Salsburgh and Black Loch. The importance of marine zones as indicating horizons is pointed out, and maps are inserted showing by lines ("isopachytes") the thicknesses of selected seams in different parts of the areas which they underlie.

A NEW contribution to the problem of the clouds of vapour emitted by volcanoes is made by Mr. F. A. Perret in a paper on the eruption of Stromboli in 1915 (*Amer. Journ. Science*, vol. xlii., p. 462, 1916). The author observed that, without change in the conditions of eruption, a cloud was absent from the crater on a fine day, accompanied by a dry state of the air, but was copiously present when a chill moist wind supervened. A great cloud of vapour may thus be merely a condensation from the air on nuclei sent upwards by the volcano, and affords no indication of the condition of activity.

THE Geological Survey of New South Wales has published (1916) a "Bibliography of Australian Mineralogy," by Dr. C. Anderson, arranged under authors, States, and localities within each State. To find the reference to dundasite, for example, it is necessary to remember that it comes from Tasmania, or to look for it under each separate State. The completeness of the work is evidenced by the inclusion of Dr. Prior's paper, in which he compares this mineral with specimens from North Wales. Considerable selection, however, must have been exercised in dealing with references to Australian gold.

PROF. FILIPPO EREDIA, of the Italian Meteorological Service, has recently issued a manual of instruction in the use of meteorological instruments and for the taking of meteorological observations. The work in general get-up somewhat resembles the "Observer's Handbook" of our own Meteorological Office. A feature is the large number of illustrations, which are unusually clear and sharp. This manual of instructions has been brought out to normalise the work carried on at the widely spread network of stations in Italy and her colonies. We are surprised to find on Fig. 24 a representation of Six's thermometer, the defects of which are well known. Prof. Eredia has also sent an interesting pamphlet on the "Climate of Ghadámes," an oasis in the interior of Tripoli, 500 km. to the south of Tripoli, at a height of 340 m. above the sea. Ghadámes is in lat. 30° 8′ N., long. 7° 10′ W. The series of observations discussed comprise two sets, the first taken from the middle of August to December, 1861, while the second embraces the period June, 1913, to October, 1914. Dealing with the later series, the mean temperature, brought to a true average by comparison with Tripoli, is 23° C., the warmest month being August, with a mean of 33·8°, and the coldest January, with a mean of 11·1°. As compared

with Tripoli, June is 0·2° warmer and December 2·6° colder. In the period under notice measurable rain fell on only five days, to the amount of 20 mm., and on fifteen others a few drops fell. The maximum fall noted was 8 mm. on February 14, 1914, with a N.W. wind. The cases of precipitation noted occurred principally with winds from the north-west and south-east. Winds are fairly evenly distributed round the compass, there being no marked excess from any one direction. In the year there were 251 cloudless and only twelve overcast days, the latter confined to the months November to March.

THE theory of the immobility of the ether is advanced by Prof. P Zeeman in a short article in *Scientia* for February (pp. 122–29). In addition to referring to the experiments of Fizeau and of Michelson and Morley, the author mentions a recent redetermination which he undertook in 1916, using monochromatic light. The results fully confirm Fresnel's formula, as completed with Lorentz's term, and the hypothesis of an immobile ether is in entire accord with the observed effects.

IN contributing a paper on "Impact in Three Dimensions" to the Proceedings of the Royal Irish Academy (xxxiii., Section A, No. 6), Prof. M. W. J. Fry has developed a subject on which a great deal evidently remained to be said over and above what is contained in Routh's "Rigid Dynamics." Some of the results are almost at variance with preconceived ideas on the subject. For example, while the velocity of compression can only vanish once in the two-dimensional problem, it may vanish three times in an impact in three-dimensional motion.

AN interesting note on the colouring matter of red torulæ, by Mr. A. C. Chapman, appears in the *Biochemical Journal* for December, 1916. Study of this colouring matter showed that it resembles carrotene in being practically insoluble in water, in dissolving to a blue solution in concentrated sulphuric acid, and in the fact that its chloroform solution, when warmed and exposed to the light, quickly becomes colourless. But comparison of the absorption spectrum of the torulæ colouring matter with that of carrotene showed that the two are by no means identical.

THE Journal of the Franklin Institute for March contains the address delivered before the institute in October last by Prof. L. V. King, of McGill University, on the acoustic efficiency of fog-signal machinery. After a review of the work on fog signalling done by the committee of the Trinity House in this country and by the lighthouse boards of the United States and of France, he describes his own measurements made in 1913 in connection with the fog-signal plant at Father Point, Quebec. The sound-producer there is a compressed-air siren of the Northey type using air at 25 lb. per square inch and giving a note of frequency 180 per second. During the actual emission of the sound 100 horse power is used. By measurement of the temperature of the issuing air when sound was produced and when not, it was found that only about 2·4 horse power was converted into sound. Tests of the intensity of the sound received at points on the water up to eight miles from the source were made by means of the sound-meter of Prof. A. G. Webster, of Clarke University, which depends on the motion of a small mirror mounted on a mica diaphragm at one end of a resonator. Zones of silence were found, on both sides of which the sound was distinctly heard. The existence of these zones appears to be intimately connected with the direction of the wind and to a less extent with the weather.

PROF. MARTIN KNUDSEN has recently described some interesting experiments on the condensation of metallic vapours on cold bodies (*Oversigt Kgl. Danske Vidensk. Selsk. Forh.*, 1916, No. 4, p. 303). When mercury vapour passes through a narrow opening into a large glass bulb containing a concentric smaller bulb tube with liquid air, most of the mercury vapour is condensed on the front of the smaller bulb facing the opening; a little passes alongside it on to the inner surface of the larger bulb, but no mercury is condensed on the back of the smaller bulb nor behind it on the larger one. The bulb with liquid air casts, as it were, a shadow, and retains all the molecules striking it. If, on the other hand, the inner bulb is only cooled with ether and carbon dioxide, the greater portion of the mercury vapour is not retained by it, and is condensed on the front half of the larger bulb. From the weight of mercury so condensed on the latter in an interval of time during which the inner bulb has only acquired a deposit thinner than the (known) limit of visibility, it is calculated that the chance of a mercury molecule being retained at its first impact on a glass surface at $-77·5°$ is less than 1 in 5000. Between this temperature and that of liquid air there is a critical temperature in the neighbourhood of $-140°$ to $-130°$. Preliminary experiments with a simpler apparatus indicate that for zinc, cadmium, and magnesium this critical temperature lies between $-183°$ and $-78°$, for copper between 350° and 575°, and for silver above 575°.

ALTHOUGH the principles that render colour kinematography possible are so simple, there appears to be an inexhaustible field for inventors in the applications of these principles, and not infrequently the details of "new" processes appear to the student of science as disadvantageous complications, if not actual infringements, of the necessary conditions. However, processes stand or fall by their results, and the *Scientific American* of March 10 states that the last "new process," as demonstrated at the American Museum of Natural History and the New York Academy of Sciences, seems to be "perfection." The simple attachments necessary can be fitted to any apparatus. A single film is used, and the pictures are taken behind a revolving four-sector colour filter, arranged with two pairs of complementary colours—namely, blue and orange, and blue-green and red. The complete element consists, therefore, of four consecutive pictures taken through colour filters in the order just named. The colour filter for projection has only two colours, red and blue, and has therefore to rotate at twice the rate of the filter disc used for taking the photographs. But each colour filter in the projector disc is subdivided into three sectors in such a way that each red and orange picture is projected through a red filter increasing in intensity in three stages, and each blue and blue-green picture in a similar way through three blue filters. The usual rate of projection is sixteen pictures per second, and Mr. G. A. Smith, in his "Kinemacolor," introduced in 1907, who used two consecutive colour pictures, found it necessary, as seems natural, to double this rate so as to maintain the same rate for each complete element. In the present case, with a quadruple element, one might expect the rate to be increased to four times—namely, sixty-four per second—but the actual rate stated is twenty-four—that is, only six complete elements per second.

OUR ASTRONOMICAL COLUMN.

COMET 1917*a* (MELLISH).—Prof. Strömgren announces that from observations made on March 22, 23, and 24 (Copenhagen) Mrs. J. Braae and J. Fischer-Petersen have calculated the following orbit and ephemeris :—

$$\begin{aligned} T &= 1917 \text{ April } 9{\cdot}4463 \text{ G.M.T.} \\ \left.\begin{aligned} \omega &= 106^\circ\ 51'{\cdot}66 \\ \Omega &= 92^\circ\ 47'{\cdot}32 \\ i &= 22^\circ\ 48'{\cdot}92 \end{aligned}\right\} & 1917 \\ \log q &= 9{\cdot}41464 \end{aligned}$$

Ephemeris : Greenwich Midnight.

1917	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ	Mag.
April 11	0 43 49	+11 30·3	9·4295	9·8894	4·6
15	0 25 7	5 48·7	9·5156	9·9206	5·2
17	0 20 53	3 32·6	9·5672	9·9407	5·6
19	0 18 45	+1 39·0	9·6172	9·9608	5·9

THE APRIL LYRIDS.—This shower of meteors, though occasionally offering a brilliant display, is, in the majority of years, very slightly visible. It is unfortunate that the period is not definitely known, though there are indications that its best returns occur at intervals of a little more than sixteen years. This feature is by no means supported on conclusive evidence, but it is a point worthy of further investigation.

Abundant showers of Lyrids were observed in 1803, 1851, 1884, and 1901, and it will be interesting to determine whether or not an unusual exhibition of these meteors is presented this year or in 1918. The time of maximum will possibly be at about midnight on April 21, and as there will be no moonlight to interfere, it will be easy to ascertain the character of the display should the weather prove suitable. If the meteors reappear at the time mentioned it will be important to observe the time of maximum and the horary number visible. The position of the radiant is already well known, and it moves eastwards, like that of the August Perseids. Though the chief activity of the Lyrids seems confined to a few hours, yet there are occasional specimens certainly seen between April 16 and 26, and possibly on dates still further removed from the night of maximum.

VARIABILITY OF URANUS.—Prof. E. C. Pickering has announced an interesting discovery which has followed from a series of photometric observations of the light of Uranus, made by Mr. Leon Campbell with the primary object of investigating possible changes in the light-emission of the sun (Harvard Circular, No. 200). The observations revealed a variation in the light of the planet amounting to about 0·15 magnitude in a period of 0·451 day, these figures being based upon 2960 settings. The period of variation agrees very closely with that of the rotation of the planet derived from spectroscopic observations by Lowell and Slipher, and Prof. Pickering concludes that the variation in light is due to unequal brightness of different portions of the planet. If the variations in brightness prove to be permanent, photometric observations will give the rotation period of the planet with a high degree of accuracy.

THE "ANNUAIRE ASTRONOMIQUE" FOR 1917.—The issue of this well-known publication for the current year contains the usual astronomical information in a convenient and interesting form, together with a review of the progress of astronomy. It forms a valuable work of reference for astronomical data of all kinds, including a catalogue of minor planets arranged in the order of their distances from the sun, a list of temporary stars which have been visible to the naked eye, a list of stars with large proper motions, and so on. Among the 140 illustrations we note a useful set of diagrams from which one can readily ascertain the visibility of each of the principal planets on any night of the year. M. Camille Flammarion is to be congratulated on having so successfully conducted this publication for more than half a century.

HEAT ECONOMY IN METAL MELTING.

THE outstanding feature of the proceedings at the annual meeting of the Institute of Metals, held at Burlington House on March 21 and 22, was a general discussion on metal melting, organised by the council. Whether it was chiefly due to the fact that this subject aroused an unusual amount of interest among the members, or that war problems in metallurgy have created a desire to discuss those problems more freely than hitherto, the fact remains that in the last three months the institute has added more new members than it did in the previous two years; that the attendance was very much larger than it has ever been at any other meeting in the course of its history; and that the discussions on the various papers contributed were of unusual fullness and value.

Special appropriateness attached to the fact that Sir George Beilby, the president of the institute, in entering on his second year of office, presided over a discussion which must have been of considerable interest to him in his capacity of Director of the Fuel Research Board set up by the Committee of the Privy Council for Scientific and Industrial Research. Although coke constitutes the fuel most generally used in metal and alloy melting, only one paper was contributed dealing with its use. On the other hand, four papers were concerned with coal-gas, and these included one on the practice of the Royal Mint, and another on the application of the high-pressure gas system installed by the City of Birmingham Gas Committee. Of the remainder one paper dealt with producer gas, another with oil fuel, and a third with an electric resistance furnace. All these papers dealt with the melting of metals and alloys in crucibles, *i.e.* in quantities which seldom exceed 200 lb. in weight. The one paper on the subject dealing with principles rather than practice was by Dr. Carl Hering, an expert on furnace construction, and was entitled "Ideals and Limitations in the Melting of Non-Ferrous Metals." This, in many respects the most suitable for discussion, was not discussed by any of the speakers, and will be briefly commented on in this article.

Dr. Hering enumerates the directions to which perfection points as follows :—A reduction in (i) the loss of heat, (ii) the loss of metal, (iii) the number of bad castings, (iv) the consumption of equipment, and (v) the cost of labour and plant per lb. of good castings. As these are not all independent factors, economy may sometimes result from increasing some if others are thereby reduced more greatly, *e.g.* increased plant cost may save more in labour cost, and an increase in bad castings may even be warranted by the great saving of heat and labour due to working faster

With regard to heat losses, Dr. Hering points out that one of the first things to bear in mind in all high-temperature thermal operations is that insulation against heat loss is in practice at best very poor; that the ideal in this direction is the vacuum jacket of the Dewar thermos bottle, but that this, unfortunately, is impracticable for metal melting. Hence, so long as the metal is hot, just so long will this loss continue. Heat losses, however, depend not only on the thermal insulation, but quite as much also on the length of time during which they take place, so that reducing

the duration of these losses reduces them in proportion. To obtain economy in heat, therefore, the ideal is not only to insulate as well as practicable, but also to heat and cast the metal in as short a time as possible, and this ideal may be approached by having each lb. of metal heated for the shortest possible time. *The total loss of heat per lb. of metal while it is hot is the criterion.* From this point of view Dr. Hering states that the ideally perfect melting furnace, if such it can be called, is the electric fuse, in which the intended result is completed in such an exceedingly short time—a fraction of a second—that the heat losses during that time are vanishingly small, and hence the thermal efficiency is practically 100 per cent.

With fuel heating, too great a rapidity of heating generally involves high chimney losses, *i.e.* a lower efficiency in heat transmission to the metal, and hence a limit to the speed is soon reached; but with electric heating there is no chimney loss, and the possibilities of rapid heating are therefore more encouraging. Electric arc heating involves high radiation losses from the arc itself, but in heating the metal by its own resistance the heat can be generated below the surface and in the metal itself, thereby eliminating all heat transmission losses. Extremely rapid heating then becomes possible, being limited only by the size of the heat-generating capacity provided, and in the case of brass or zinc by the volatilisation of the zinc in the part in which the heat is set free. By the resistance method, therefore, the ideal represented by the electric fuse can be approached more closely than by any other known method. Small high-speed furnaces are therefore, from this point of view, an approach to the ideal, particularly as they involve the minimum of contamination of the metal being melted. In Dr. Hering's opinion, it will in time become possible, for light castings at least, to be melted in an electric furnace about as fast as the metal can be cast, in which case the furnace would need to have a metal capacity of only enough for about two moulds. In that case it would be so small that it could be transported to the moulds, thereby saving the usual large heat losses in the transporting crucibles, besides the heat losses in the crucibles themselves.

Another factor, however, is involved, viz. the larger the amount of metal in a furnace, the less the *rate* of heat loss per lb., because the larger the volume, the less is the surface exposed. In a large furnace with a hemispherical hearth the heat loss per lb. of metal through walls having uniform insulation is reduced to about one-half when the capacity is increased from 1 to 10 tons. Hence, for this reason, the larger the furnace the better.

In choosing between these two apparently conflicting ideals the following considerations must be borne in mind:—(i) When melting is the only object, then the metal should be kept hot the shortest possible time; hence there should be used as small a furnace as is consistent with the amount of metal required for one casting. (ii) When there are involved operations such as refining, mixing, uniformity of alloying, the taking of specimens for analysis while melted, or any other process requiring time, the larger the furnace the better.

LIQUID FUEL.

"LIQUID Fuel and its Combustion" was the title of a paper read by Prof. J. S. S. Brame, on February 20, before the Institution of Petroleum Technologists. Attention was directed to the increasing use of liquid fuel, and especially to its connection with those developments of the internal combustion engine which have so largely determined the progress of aviation and submarine navigation. Nevertheless he recalls the warning of Redwood (1905) that no oil supplies are in sight sufficient to replace anything like the bulk of solid fuel consumed. The use of liquid fuel for steam raising and industrial heating is the special subject of the paper, and the following considerations are brought forward. In constancy of chemical composition, whatever the source, and therefore of calorific value, mineral fuel oils compare very favourably with coal, and accordingly physical considerations such as low viscosity and freedom from grit may decide the choice of oil fuels. Turning to our home supplies, it is gratifying to note that the heavy fractions of the Scotch shale oils are ideal in this respect; having been distilled they are clean, while their fluidity is very satisfactory. Another home product, which is deserving of the close attention of liquid fuel experts, is coal-tar, the supply of which must increase with the extension of coal carbonisation. Its production may outgrow its uses in normal channels, and as a home-made liquid fuel its rational utilisation is a matter of high national importance. Nevertheless, for marine purposes tar (and tar oils) must remain inferior to petroleum, since a higher oxygen content and lower calorific value are inevitable, while a capacity for giving off disagreeable fumes may make it objectionable in the confined space of a stokehold. Methods of burning oil are surveyed historically, leading up to the spray burners now almost invariably used which "atomise" the oil.

The method of spraying is varied, depending on the use of compressed air or steam, or on forcing oil alone under pressure through a suitable burner, a method specially adapted for use in marine boilers. On theoretical grounds air injection would seem to be most generally efficient; steam may propel oil satisfactorily into the fire, but afterwards its influence on combustion can only be of negative value. The general arrangements of the system for combustion have more bearing on the success of a plant than the choice of atomiser. It is too often overlooked that, compared with solid fuel, where burning is mainly confined to the fuel bed, oils require a much greater volume of combustion space.

Looking to the future, Prof. Brame points out how much depends on the development of the internal combustion engine; for naval purposes he believes that oil firing with turbines will hold the field.

J. W. C.

RECENT PROGRESS IN SPECTROSCOPY.[1]

II.

RADIATION is an electromagnetic process, and must be determined by the electrical state of the radiator. A molecule may be neutral or for a moment charged by the loss or gain of an electron. This type of ionisation must actually occur, as indicated by the conduction of electricity through the vapour of a compound which shows no evidence of chemical dissociation. What causes the light emission? It may accompany the loss or gain of an electron by a neutral molecule, in which case the emission centre would be charged. It may be due to the shock of elastic collision with an electron or ion, or to the reunion of an electron with a positively charged molecule, in which cases the emission centre would be neutral. Luminous vapours emitting band spectra usually appear to be neutral at the instant of emission, so that it seems probable that band emission is due either to elastic shock or to the

[1] Address delivered to Section B—Physics—of the American Association for the Advancement of Science at the New York meeting, December, 1916, by the chairman of the Section, Prof. E. P. Lewis. Continued from p. 118.

recovery of a lost electron. It is to be remarked that as a rule band spectra are not subject to the Zeeman, Stark or Humphreys-Mohler effect; in the exceptional cases it is probable that those subject to one of these effects are subject to all. It would be of interest to examine these cases with reference to the nature of the molecular charge.

Luminous vapours emitting line spectra appear, in many cases at least, to be positively charged. A sodium flame is attracted to the negative plate of a condenser. A metallic salt introduced near the cathode of a spark discharge colours the spark only in that neighbourhood; if introduced near the anode, the colour flashes entirely across the spark. The most promising method of verifying such conclusions appears to be by the study of canal or positive rays. Sir Joseph Thomson, from a study of the deflections produced by magnetic and electric fields, found that, with very few exceptions, no molecules of either elements or compounds carry a negative charge, while those with positive charges are common. No molecule acquires more than one positive charge. The atoms of but few elements are found with a negative charge, but all may acquire positive charges and many may be multiply charged. For example, krypton may have as many as five and mercury eight positive charges. Hydrogen never has more than one charge, which accords with Bohr's view that it has but one detachable electron.

Stark has reached similar conclusions from a study of the spectra of canal rays. In many cases the motion in the line of sight gives a Doppler effect. There is an undisplaced line due to the stationary gas and a displaced line due to the canal rays. A distinct separation between the displaced and stationary lines shows that the canal rays cannot radiate until their kinetic energy reaches a threshold value, which Stark first interpreted in favour of the quantum theory, but which he now believes to represent the energy necessary for ionisation. There may be two or even three displaced lines, with separations consistent with the view that the luminous centres are doubly or triply charged. The radiation is evidently due to collisions, for a reduction of pressure in the canal ray chamber causes a reduction of luminosity. In general, all series lines are subject to the Doppler effect. Fulcher has shown that nitrogen canal rays give the negative pole band spectrum, with displacements, but no other bands have been found to give this effect. The series lines of hydrogen show displacements, but they are not observed in the many-line spectrum except to a slight extent in a few cases. Stark concludes that the series lines are emitted by positive atom ions, and the lines of the secondary spectrum by neutral atoms. He thus associates the compound spectrum with band spectra, which he supposes to be due to neutral systems. It may be remarked that Fabry and Buisson have concluded from measurements of the width of lines that both spectra are due to emission centres of atomic size. From a study of the displaced components of many elements, electronegative as well as electropositive, Stark concluded that in all cases line spectra are emitted by positively charged atoms. Aluminium atom ions may have one, two, or three charges, which appear in succession as the voltage is increased. The same is true of argon. The red spectrum is apparently due to singly charged ions, the blue or spark spectrum to multiple charges. Mercury may have as many as four charges, each giving rise to a characteristic group of lines, all those due to multiple charges being spark lines. From an examination of many such cases Stark concludes that in general arc lines or those of the positive column are due to singly charged ions, sharp spark lines to double charges, and diffuse spark lines to triple charges. There are some apparent exceptions to this classification, but in the main the evidence seems to support his views, which are also consistent with the results obtained by Reichenheim from the study of anode rays. For the first time we are thus enabled to assign a common cause for spark lines produced under apparently very different conditions. They are found in the spectra of disruptive discharges, of the negative glow in vacuum tubes; in the intermittent or oscillating arc when rapid changes in potential occur, although the maximum potential may be small; near the poles of the arc, where the anode and cathode potential gradients are steep; in the electric furnace when the temperature is high; in high temperature stars, and, as found by Hemsalech and de Watteville, even in the green cone of the Bunsen flame, where chemical action is energetic. In all these cases we might expect multiple ionisation to be favoured.

Similar conclusions regarding the charges of emission centres may be derived from observations by Stark, Child, Strutt, and others on the luminous vapours from an arc between charged condenser plates. The carriers of the line spectra are swept out of the field, while the luminous vapours giving band spectra are unaffected; or, if the lines of several series are present, their intensities are modified in different degrees by the electric field. Studies of the oscillatory spark by Schuster and Hemsalech, Schenck, Milner, Royds, and others indicate that the spark lines do not persist as long as arc lines. If the emission centres of the former are multiply charged this is what we might expect.

Investigations on the mechanism of the spark give results which at first sight seem opposed to Stark's theory. All observers agree that the luminous vapours appear to be projected from the cathode, with different velocities for different lines, and the tacit assumption seems to have been made that they are negatively charged. That metallic vapours are projected from the cathode is evident from the fact of cathode disintegration, and probably the particles are initially negatively charged. We know very little concerning this phenomenon, but two things are almost certain—that only a small fraction of the metallic particles take part in the luminosity, and that these particles are not negatively charged while radiating. The large velocities indicated by the curvature of the streamers viewed in a rotating mirror do not give rise to a corresponding Doppler effect, and it seems highly probable that Hull and Royds are correct in their surmise that what happens is really the propagation of a condition of luminosity through vapour which continuously fills the gap after the first discharge. Electrons initially projected with a high velocity, which diminishes as the field intensity drops to zero, and producing multiply charged ions in the beginning and singly charged ions towards the end of their course, would apparently account for all the observed effects.

While the experimental evidence seems to favour the idea that lines are emitted by positively charged centres, there is no *a priori* reason why neutral or even negative ions should not emit line spectra. It is quite possible that the canal ray lines which Stark attributes to singly charged ions may be emitted at the instant of neutralisation; but we cannot escape the conclusion that spark lines at least are emitted by positive ions unless we accept the improbable view that a multiple charge may be instantaneously entirely neutralised. Lenard inferred from the distribution of emission centres in the arc that the lines of the principal series are emitted by neutral atoms, those

of subordinate series and spark lines by multiply charged atoms. Wien and others have suggested that line spectra may be emitted by molecules, but this seems improbable. On the other hand, we must admit the possibility of negatively charged centres which would probably exist only under exceptional conditions. Nicholson has, with success, assumed the existence of positive, neutral, and negative centres in accounting for the spectrum of the corona.

The fundamental importance of reaching definite conclusions as to the magnitude of the electric charge of emission centres is evident when we remember that any theory must take this into account. Bohr's theory rests upon the assumption that series lines are emitted by electrons previously detached as they return to equilibrium positions determined by the resultant charge of the system. In the case of hydrogen, if there be but one detachable electron, the radiating system must be neutral. If it can be shown without question that the emission centres of the Balmer series are positively charged, some modification of the theory seems necessary. Furthermore, if the centres are thus deprived of the one detachable electron, we must accept Stark's view that the series emission is due to electrons which cannot be detached. Fulcher has pointed out the necessity for a similar conclusion with respect to helium. Some of its lines are attributed to doubly charged atoms; but these are identical with alpha particles, the nuclei of the atoms, from which the radiation must be emitted.

Beyond the probable fact that band spectra are usually emitted by neutral systems, there is little evidence upon which we may rest a theory. Emission may accompany the neutralisation of a positively charged molecule by an electron or may be the result of internal vibrations due to collisions, without complete ionisation. Stark believes that the band emission is due to the detachable valency electrons, although the coupling between them and more firmly bound electrons may cause the latter to take part.

Evidence supporting Stark's views is to be found in absorption spectra. Hydrogen shows no absorption until it is ionised by a current. The cold vapours of the alkali metals and of mercury show line absorption, but their susceptibility to the photoelectric effect indicates how ionisation may be the prelude to absorption. All the corresponding emission lines appear to be due to singly charged emission centres. Absorption of the lines due to multiple charges does not take place until the vapour is highly ionised by electric discharges or high temperature. Substances which show band absorption under ordinary conditions, such as iodine, do not appear to be ionised when either emitting or absorbing. Both processes appear to be due to neutral systems. In such cases emission must be due to internal disturbances, without ionisation. The bands of some substances, such as nitrogen, are not found in absorption under any conditions, and the conditions of their occurrence indicate that the emission bands are due to the recombination of a detached electron with a positive molecule. The negative pole bands appear under the same conditions as spark lines, and it seems not improbable that they are due to the neutralisation of a doubly charged molecule.

The spectral differences attending different stages of ionisation are well illustrated by some recent experiments. Franck and Hertz found that mercury vapour is ionised by a field of 4·9 volts, and then emits the one ultra-violet line 2537. The Einstein relation $Ve = h\nu$ is fulfilled. McLennan and Henderson verified this conclusion, and also found that with a field of about 12 volts a second stage of ionisation occurs, attended by the emission of the many-lined spectrum attributed by Stark to multiple charges. McLennan finds that zinc, cadmium, and magnesium also give single line spectra which probably conform with Einstein's equation, which we should not expect to apply in a simple form to the many-line spectrum.

It appears from such experiments that there is a threshold value of kinetic energy which must be imparted to an emission centre before it can radiate, which represents the work of ionisation and is equal to a light quantum. Franck holds that this energy may be devoted either to ionisation or to emission, but that both cannot simultaneously occur. Stark believes that the two are coincident, the emission accompanying the rearrangement of electrons in the atom after one has been ejected. This suggests an explanation of quantum emission involving no departure from accepted electromagnetic theory.

The spectra of hydrogen and of helium are of particular interest because their atoms are of the simplest type and because it is possible that they are the basic units of which all elements are composed. The Pickering series in stellar spectra was attributed to hydrogen because of its numerical relationships with the Balmer series. The study of series relations led Rydberg to predict the occurrence of a principal series for hydrogen beginning at wavelength 4686, and this line was subsequently found in nebular and stellar spectra. After many attempts to reproduce these spectra in the laboratory, Fowler succeeded in 1812, by passing a powerful disruptive discharge through a mixture of hydrogen and helium. Produced only under such conditions, these must be classed as spark lines; and if Stark's views are correct and if they are really due to hydrogen, that element must have more than one detachable electron.

In applying his theory to the helium spectrum, and assuming one electron returning to a helium atom from which two electrons have been detached, Bohr obtained a formula which gives lines corresponding in position to those of the Pickering and Rydberg series, and also another series almost coincident with the Balmer hydrogen series. This remarkable conclusion was strengthened by Stark's discovery of 4686 in a helium tube which gave no lines of the ordinary hydrogen spectrum. He concluded from the canal-ray displacements that the emission centres were doubly charged. Evans also found the first members of all the series assigned to helium by Bohr, including that corresponding to the Balmer series, in a tube containing no hydrogen. The experimental evidence thus favours Bohr's theory, but we must remember the remarkable way in which the presence of one element may intensify or suppress the spectrum of another. For example, Lyman found that the ultra-violet series attributed without question to hydrogen is greatly intensified by the presence of helium. It may be added that Merton has concluded, from a study of the width of 4686, that it is due to an atom smaller than that of helium.

Some light may be thrown on this problem by observations such as those made by Wright and others on the distribution of materials in nebulæ, as indicated by the length of the nebular lines. Wright finds that usually 4686 is confined to the nucleus; helium lines extend further, and those of nebulum and hydrogen still further. These results favour the view that the elements distribute themselves according to their atomic weights, and that 4686 is due to an atom at least as heavy as that of helium. But this is not conclusive, because a high temperature line of hydrogen might be found only in the hot nucleus, if we grant the possibility of a higher degree of ionisation for hydrogen.

Fundamental questions which are of importance to

physicists and astronomers alike are involved in this problem, but it is evidently an elusive one. Curiously enough, as Fowler has proved by comparison with other spectra, general series relations would permit us to assign the disputed series to hydrogen or to helium impartially, and it seems possible that both elements may give the same spectrum under appropriate conditions. Bohr has also concluded from the formula derived from the assumption of the return of an electron to a lithium atom which has lost three electrons, that lithium would emit lines close to the Balmer series. Bohr has not yet succeeded in applying his method to the case where an electron returns to a singly charged helium or lithium atom, and hence has not been able to account for the known helium lines, which are assigned by Stark to singly charged atoms. Nor has he taken account of atomic magnetic fields, which, as Humphreys, Allen, and others have shown, may exercise an appreciable influence.

One of the most fascinating fields of research is that of fluorescence and resonance spectra, in which much work has recently been done, particularly by Wood. He has found that white light will excite the complete band and line resonance spectrum of sodium or iodine, but that a single exciting line will cause the emission of a line of the same length, and also of a number of lines approximately equally spaced which may not always coincide in position with one of the absorption lines. Thus the vapour is caused to emit forced vibration, giving a spectrum not its own. As Wood has suggested, this method enables us to strike one key of the complex vibrating system of the atom, instead of the whole keyboard at once. Time does not permit a detailed account of this remarkable work, but it is evident that it may render great service in the study of the mechanism of the atom. Nor is there time even to mention any of the results obtained in the field of absorption spectra.

After reviewing the work of the past decade, we may feel encouraged by the progress that has been made both in the perfecting and application of spectroscopic methods of research and in the discovery of new phenomena. Some of these discoveries have led to fundamental revisions of our notions of atomic structure. The Rutherford atom has definitely displaced that of Thomson. In some respects this has seemed to make the problem more difficult, but it has at least defined it more precisely. Many attempts have been made to represent an atomic structure which would satisfy the necessary mathematical conditions, most of them so impossible as to be absurd or so speculative that they suggest no experimental tests of their validity. The great merit of Bohr's hypothesis is that it does lend itself to such tests, and it is for that reason that I have paid special attention to the methods of experimental attack which seem to give the most concrete results in this connection. Hesitant as we may be to accept in all its details a theory which asks us to abandon laws upon which we have pinned our faith, this theory, and the quantum theory as well, may be the flashes of genius which reveal incompletely the outlines of the truth towards which we struggle along a dimly lighted path. Fuller knowledge may resolve some of our difficulties and reconcile apparent contradictions. Ptolemy's theory of epicycles would appear wholly irrational to one acquainted with Newton's laws but ignorant of Kepler's conclusions, yet it correctly described the facts as Ptolemy saw them. Some day the Kepler and the Newton of the atom may appear, but their task will not be an easy one. If the astronomer is baffled by the problem of three bodies which he can see, how can we expect to define the exact laws determining the motions of the invisible hosts of electrons and positive charges in an atomic system? How can we hope to picture correctly the mechanism which emits radiations of almost infinite complexity, or account for the additional complications called forth by external forces? We may be almost tempted to accept the pessimistic view expressed by Planck in his Columbia lectures, that nothing in the world entitles us to believe that it will ever be possible to represent completely through physical formulæ the inner structure of the atom. And Kayser has said: "A true theory must assume a complete knowledge of electrical and optical processes, and therefore is a Utopia."

But even if we never reach the goal, who can set a limit to our approach to it? We may never set foot upon the promised land, but some day we may perceive its shadowy outlines dimly from afar.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, Sheffield, and Birmingham has revised its regulations for entrance to the faculties of medicine, and no longer requires that Latin should be taken as an obligatory subject. The conditions imposed by the board for entry to the faculty of medicine are now identical with the general conditions for entrance to the several faculties of the Universities.

WE learn from *Science* that the library of the late Prof. Hugo Münsterberg has been given to Harvard University by a group of his friends. The library consists of about 10,000 books, pamphlets, manuscripts, charts, and other papers. Among the 3000 books in the collection are the latest and most valuable on experimental and applied psychology, especially those bearing on aspects of the subject to which Prof. Münsterberg had devoted his time.

ACCORDING to a recent article in the *Frankfurter Zeitung* and an interview with a prominent librarian at Frankfort plans are being considered for the establishment of a general technical library at Frankfort-on-Main, to be open for public use. One of the leading city libraries has become interested in the project, and a beginning has already been made. A demand exists for a library which will be of service to all the numerous branches of the industry and trade in and about Frankfort, the most important industrial centre in South and West Germany. In this manner a broader spirit of scientific and technical investigation will be fostered. An attempt will be made to furnish technical information which will have a historical as well as a purely scientific value. Technical libraries have existed previously, but they have not been open to the general public. Such libraries have been the property of scientific societies, technical associations, and the larger industrial concerns. The service rendered by these scattered collections was comparatively small, as it was limited to members of the respective organisations owning them. These were usually hampered by lack of means and lack of facilities for organising and arranging to the best advantage. The plan that is now under way would combine these private and semi-private libraries and put them under the control of one of the established city libraries at Frankfort-on-Main. The library chosen for the purpose is the Frieherrliche Carl von Rothschildsche Offentliche Bibliothek. In addition to technical books, it is stated that the chief technical magazines of Germany and of the world are to be placed at the disposal of the public. A special feature will be the department for patent publications. Not only will

the important German patent publications be provided for the library, but an attempt will be made also to furnish as broad an international list as possible.

The South-Eastern Agricultural College has organised a research and advisory department, which is distinct from the teaching side of the college, and is governed by a separate representative committee under definite terms of reference from the governing body. This committee is composed not only of the chief research workers at the college, but also of prominent scientific men who have been co-opted to serve in advancing this side of the college activity. This seems to be an admirable arrangement. The Wye College has recently issued a very interesting memorandum outlining the work in progress and contemplated by the research department. The researches referred to are: (i) Problems connected with the general practice of fruit-growing; (ii) problems connected with the treatment of fungous diseases and insect pests by spraying; (iii) the biological study of fungous diseases and insect pests; (iv) flax experiments; (v) problems connected with the conservation of fruit and vegetables; (vi) pasture studies; (vii) investigations in diseases of sheep; and (viii) hop-breeding. The Wye College Fruit Research Station is situated in the centre of the most important fruit- and hop-growing district in the country, and it is clear from the memorandum that the main lines of research are concerned with these industries, although in almost every instance the other researches referred to have some special interest in the college area. With regard to fruit-growing, special attention is being given to the selection and classification of fruit-tree stocks, with the object of obtaining "pedigree" strains of well-known varieties, and afterwards it is proposed to investigate the relationship between "stock" and "scion." The study of fruit-growing includes the problem of combating the many fungous diseases and insect pests which become prevalent in intensively cultivated fruit areas. For the purpose of these researches the college enjoys quite a unique opportunity, being the only horticultural research station which is actually surrounded by a large fruit-growing district.

Those who desire to see the study of physical science receive its due proportion of school time, of prizes and scholarships and other forms of encouragement, as well as social distinction equal to that traditionally allotted to scholars brought up on purely literary fare, will rejoice to notice the newly developed liberalism of some of the classical leaders. Mr. A. C. Benson's paper at the Royal Society of Arts on December 20 last was noticed in Nature of February 1, and now we find, in the *Fortnightly Review* for April, an article by Lord Bryce entitled "The Worth of Ancient Literature to the Modern World" (annual presidential address to the Classical Association). This article concedes almost everything fundamental which has been demanded for many years past by the advocates of educational reform. It is no doubt true, as stated by Lord Bryce, that the present popular desire for more science has been created, not as a result of any appreciation of its educational value or of pride in the achievements of the human intellect, but as a consequence of the association in the minds of the people between a knowledge of applied science and material prosperity. This is no ground for refusing to satisfy the demand, which, for other reasons, is fully justifiable. The time has come, we are told, when everyone should approach the subject, not as the advocate of a cause, but in an impartial spirit. Then Lord Bryce goes on to inquire, What is the chief aim of education? And the reply is: First, teaching the child how to observe, and from the beginning directing his attention to external Nature. Along with this he must be taught how to use language so as to be able to convey accurately what he wishes to say. An article by Mr. H. G. Wells follows that of Lord Bryce, and the subject is a review of Mr. R. W. Livingstone's recent book entitled "A Defence of Classical Education." It supplies interesting and amusing reading, which will be relished probably by everyone except the author of the book.

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, March 21.—Mr. E. Heron-Allen, president, in the chair.—K. W. **Goadby**: The bacteriology of war wounds. With the aid of lantern slides and photomicrographs, prepared by C. F. Hill, the chief bacteria peculiar to the septic wounds encountered in the present war were demonstrated and described in connection with the lesions they produced.

Manchester.

Literary and Philosophical Society, March 6.—Prof. S. J. Hickson, president, in the chair.—Dr. H. **Wilde**: An Egyptian meteorite. Capt. Cyril Norbury, of the 7th Manchester Regiment, observed the fall of this meteorite in August, 1916, while engaged in military operations in Egypt at the extreme north of the Sinai Peninsula. The fall occurred in the early afternoon, and was attended by a loud whizzing, followed by a great thud. It was at once decided that the sounds were caused by an enemy bomb that had failed to explode, but on further search with a spade of the spot where the body had disappeared it was unearthed. Capt. Norbury noticed that a portion of the meteorite was missing, but although a careful search was made the missing portion could not be found. He also mentioned that a similar occurrence took place at the same time fourteen miles away, though the meteorite in that case was never found, but the 6th Manchesters heard a similar buzzing through the air. The weight of the meteorite is nearly 3·5 lb., and the missing parts would be about the same weight. The thin pellicle on the surface of the stone (0·02 in. deep) through which it becomes vividly incandescent during its passage through the atmosphere is indubitable evidence of its identity with those in the collection of similar meteorites in the British Museum. The Egyptian meteorite is an amorphous silicate, grey in colour, and contains microscopic particles of iron, which are diffused throughout the mass and cause a magnetised needle to adhere to any part of its surface.—Dr. A. D. **Imms**: Remarks on "castration parasitaire" in insects, with special reference to Termites. The author referred to the occurrence among diverse groups of insects of the phenomenon termed by Giard "castration parasitaire." The most striking examples are afforded by the parasitism of bees of the genus Andrena by the aberrant insect Stylops, of Bombus by the Nematode Sphærularia, of leaf-hoppers by the dryinid Aphelopus and the pipunculid Chalarus, and of the ant Pheidole by the Nematode Mermis. In Termites, Grassi and Sandias (1893) pointed out that vast numbers of parasitic Protozoa occur in the hind-intestine of the sterile castes, but not in the sexual forms. They concluded that in the former castes the degeneration of the gonads and the production of soldiers and workers are correlated with the presence of Protozoa. In the primitive Himalayan Termite Archotermopsis, Dr. Imms stated that the gonads of the so-called sterile castes are as well developed as in the sexual forms, though abundant Protozoa occur. In species of the genus Eutermes the gonads are extremely degenerate or

wanting, and Protozoa are absent. The latter occur only among wood-feeding Termites, and are possibly symbiotic rather than parasitic. The balance of evidence is entirely opposed to the occurrence of "castration parasitaire" among Termitidæ.

PARIS.

Academy of Sciences, March 12.—M. A. d'Arsonval in the chair.—M. **Tisserand**: The mechanical culture of soils. The replacement of animals by motors on the land, already commenced before the war, has now become necessary. Attention is directed to a work by Capt. Julien, entitled "La Moticulture," in which the construction and use of such apparatus are fully discussed.—R. de Montessus de **Ballore**: Left algebraic curves.—M. **David**: The estimation of ozone. An acid solution of ferrous ammonium sulphate is used to absorb the ozone, the amount being determined by a titration with centinormal potassium permanganate.—F. **Grandjean**: The visibility, above the temperature of isotropic fusion, of boundaries of contact between the anisotropic liquids and the crystals.—H. **Hubert**: The diabases of Foula-Djalon and their contact phenomena.—M. **Jean**: The influence of extracts of genital glands on phosphorus metabolism. The injection of extract of interstitial gland and that of the yellow body from the ovary of the pig both cause a diminution in the phosphate excreted.—J. **Laborde**: The reactions of white turbidity in wines.—Em. **Bourquelot** and A. **Aubry**: The crystallisation and complementary properties of the galactobiose previously obtained by biochemical synthesis. The authors have now succeeded in preparing in crystallised form the galactobiose, the synthesis of which was described in a previous paper. As had been surmised, this sugar shows multirotation.—J. **Amar**: The classification of mutilations of the locomotive apparatus and incapacity for work.—Mlle. Marie **Goldsmith**: Some sensorial reactions of the octopus. This Cephalopod is capable of distinguishing colours, since associations can be established between the colour of an object and the sensation of feeding. There is proof of memory, but it is of short duration.—O. **Duboscq**: A new Sporozoa, *Selysina perforans*.—E. **Roubaud**: Auto-inoculation and primary development in the buccal mucus of the larva of *Gastrophilus intestinalis*.

March 19.—M. A. d'Arsonval in the chair.—M. **Hamy**: The approximate values of some definite integrals.—G. **Bigourdan**: The position and co-ordinates of some astronomical stations of Paris, utilised during the construction of the observatory.—P. **Termier**: Remarks on a recent publication of M. Maurice Lugeon. An account of a memoir entitled "Les Hautes Alpes calcaires entre la Lizerne et la Kander."—Y. **Delage**: Pharmacological equivalents and therapeutic units. The author suggests a novel and fundamental alteration in the method of writing prescriptions. The number of new synthetic drugs now used in practice is so large that it has become almost impossible to remember the doses of all of them, and, it is pointed out, there are difficulties in consulting a book in the presence of a patient. It is proposed that a list of all simple drugs and compounds in use should be drawn up and a number placed after each, indicating by weight or volume, according to the nature of the drug, the average daily dose of the average adult. This would be called the pharmacological equivalent (P.E.). For convenience, to avoid decimals, a therapeutic equivalent (T.E.) one-tenth of this would be taken as the unit. A model prescription drawn up on these lines is given. It is claimed that the method proposed would have advantages for the doctor, the pharmacist, and the general public.—G. **Charpy** and A. **Cornu-Thenard**: Tests for resilience. Irregularities in results in measurements of resilience have been attributed, on one hand, to imperfections in the methods employed, or, on the other, to actual variations in the samples of metals under examination. From the results of a large number of experiments the author has come to the conclusion that the second point of view is the correct one. The resilience of a metal is a perfectly determinate magnitude, although it presents no correlation with the usual constants obtained by traction or bending.—E. **Ariès**: The pressure of saturated vapour at low temperatures and the chemical constant.—M. Haug was elected a member of the section of mineralogy in the place of M. A. Lacroix, elected permanent secretary.—E. **Lebon**: A new table of divisors of numbers.—G. **Julia**: The reduction of binary forms of any degree.—G. **Giraud**: Hyperfuchsian functions.—A. **Buhl**: The Abelian sums of conical volumes.—L. **Hartmann**: The systematic variation of the value of the kinetic energy in the elastic shock of bodies.—A. **Leduc**: Heats of vaporisation and maximum vapour pressures. A comparison of the latent heats of vaporisation of ether and benzene deduced from the vapour pressures of Ramsay and Young, and determined experimentally by Winkelmann, Regnault, and Perot. The causes of the differences, which are considerable, are discussed.—C. **Truche**: The treatment of ulcerous lymphangitis of the horse by bacteriotherapy. The preparation of a serum is described, and the favourable results obtained by its use.—M. **Ratynski**: A treatment of infected wounds.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 12, vol. ii.).—S. **Taber**: The origin of veins of the asbestiform minerals. Cross-fibre veins are formed through a process of lateral secretion; the fibrous structure is to be attributed largely to the mechanical limitation of crystal growth through the addition of new material in only one direction.—R. A. **Daly**: A new test of the subsidence theory of coral reefs. Existing coral reefs are new upgrowths on platforms which have been formed before, and independently of, the reefs. The submarine topography of each reef-platform structure as a whole, and the elementary principles of oceanography, declare against the assumption that the forms and spatial relations of atoll and barrier reefs are due to the sinking of the earth's crust.—A. **McAdie**: A new thermometer scale. It is suggested that the absolute zero and the melting point of ice be designated as 0 and 1000.—W. J. **Crozier**: The immunity coloration of some Nudibranchs. The coloration of *Chromodoris zebra* is a metabolic accident, at least in relation to its protection.—R. **Pearl**: Some effects of the continued administration of alcohol to the domestic fowl, with special reference to the progeny. Confirmation of previous calculations that the progeny of alcoholised parentage in poultry, while fewer in number, are made up of individuals superior in physiological vigour, and that this result is due to a selective action of the alcohol upon the germ-cells.—O. E. **Buckley**: An ionisation manometer. Use is made of the ionisation of gas by an electron discharge. The range of the apparatus is from 10^{-3} mm. to as low pressures as can be obtained.—H. M. **Bowman**: Physiological studies on Rhizophora. The rate of transpiration varies directly with the concentration of the medium in which the Rhizophora plants grow.—J. F. **McClendon**: The hydrogen ion concentration of sea water, and the physiological effects of the ions of sea water. It is calculated that OH', $Na^{\cdot}$, and $K^{\cdot}$ increase the permeability of the plasma membrane by causing it to swell, and that $Ca^{\cdot\cdot}$, $Mg^{\cdot\cdot}$, and $H^{\cdot}$ (at least on the alkaline side of the isoelectric point) inhibit increase in permeability by inhibiting swelling.—L. B.

Mendel and Sarah E. **Judson**: Some interrelations between diet, growth, and the chemical composition of the body. Changes in the water, ether extract, and ash content of the body have been determined under various conditions.—T. W. **Richards** and C. **Wadsworth**: Part iii. Further study of the atomic weight of lead of radio-active origin. Atomic weight of four different examples of isotopic lead not hitherto tested was determined, with the results varying from 207·00 to 206·08.—W. H. **Dall**: Some anomalies in geographic distribution of Pacific Coast Mollusca. Observations in regard to long-continued studies by the author.—W. R. **Miles**: Some psycho-physiological processes as affected by alcohol. The percentile effects of the ingestion of alcohol upon a related group of processes, such as the patellar reflex latency, lid reflex latency, and patellar reflex amplitude, were studied.—L. R. **Cary**: The influence of the marginal sense organs on metabolic activity in *Cassiopea xamachana*, Bigelow. Muscular activity is a relatively unimportant factor in determining the metabolic activity of Cassiopea.—F. **Boas**: New evidence in regard to the instability of human types.—G. P. **Baxter** and H. W. **Starkweather**: A revision of the atomic weight of tin. The value Sn=118·703 (Cl=35·457) is found.—A. G. **Mayer**: Further studies of nerve conduction in Cassiopea.—C. **Schuchert**: The earliest fresh-water Arthropods. If the Eurypterids and Limulids arose in the fresh water we can explain why they and the terrestrial scorpions do not pass through a crustacean stage. It may well be that the Trilobites retaining the nauplius stage do not give rise to these stocks. We may look for this ancestral stock in one still more primitive which seems to have permanently invaded the rivers of the land either in Proterozoic time or in Walcott's Lipalian time.—W. H. **Longley**: Observations upon tropical fishes and inferences from their adaptive coloration. The observations here presented undermine many speculative explanations of animal coloration in terms of natural selection.

BOOKS RECEIVED.

The Properties of Aerofoils and Aerodynamic Bodies. By A. W. Judge. Pp. x+298. (London: Whittaker and Co.) 15*s*. net.

Electric Traction. By A. T. Dover. Pp. xviii+667+illustrations and folding plates. (London: Whittaker and Co.) 18*s*. net.

Herbs Used in Medicine. (First Series.) With descriptive and explanatory notes by Mrs. J. D. Ellis. Pp. 32. (London: National Herb-growing Association.) 3*s*.

Clothing and Health. By Prof. H. Kinne and A. M. Cooley. Pp. vii+302. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3*s*. net.

The Pruning-Manual: Being the Eighteenth Edition of the Pruning-Book. By L. H. Bailey. Pp. xiii+407. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

The Passing of the Great Race: or The Racial Basis of European History. By M. Grant. Pp. xxi+232. (London: G. Bell and Sons, Ltd.) 8*s*. 6*d*. net.

On Growth and Form. By D'Arcy W. Thompson. Pp. xv+793. (Cambridge: At the University Press.) 21*s*. net.

The Method of Enzyme Action. By Dr. J. Beatty. Pp. ix+143. (London: J. and A. Churchill.) 5*s*. net.

Descriptive Catalogue of the Documents Relating to the History of the United States in the Papeles Procedentes de Cuba, deposited in the Archivo General de Indias at Seville. By Prof. R. R. Hill. Pp. 302. (Washington: Carnegie Institution.) 4 dollars

DIARY OF SOCIETIES.

THURSDAY, APRIL 12.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Wayleaves: C. Vernier.

OPTICAL SOCIETY, at 8.—Light Filters for Eye Protection: L. C. Martin.—Accuracy of Observation and Precision in Measurement: Dr. G. A. Carse.—Some Methods of Analysing Lens Systems: S. D. Chalmers.—A Simple Proof of the Expression for the Focal Power of a Thick Lens: C. Cochrane.

FRIDAY, APRIL 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Missing B.D. Stars: Rev. J. G. Hagen.—Observations made during the Partial Eclipse of the Sun on 1917, January 22, at the Temporary University Observatory, Rostow-on-Don, Russia. S. D. Tscherny.—The Positions of Some Pole Stars, and a New Determination of the Constants of Aberration: L. Becker.—The Motion of the Perihelion of Mercury deduced from the Classical Theory of Relativity: L. Silberstein.

TUESDAY, APRIL 17.

ROYAL INSTITUTION, at 3.—The Old Free Russia: Prof. C. R. Beazley.

ZOOLOGICAL SOCIETY, at 5.30.

ROYAL STATISTICAL SOCIETY, at 5.15.

WEDNESDAY, APRIL 18.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Life-history of the Meningococci and other Bacteria: Dr. E. C. Hort and F. Martin Duncan.—Notes on *Physarum carneum*, G. Lister and Sturgis; a New British Species: H. J. Howard.

GEOLOGICAL SOCIETY, at 5.30.—The Morphology and Development of the Ammonite Septum: Prof. H. H. Swinnerton and A. E. Trueman.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Diurnal Variation of Atmospheric Pressure at Benson, Oxon., during 1915: E. G. Bilham.—Atmospheric Electrical Phenomena during Rain: Lieut. C. D. Stewart.

THURSDAY, APRIL 19.

ROYAL INSTITUTION, at 3.—Industrial Finance after the War; The Character of the Industrial Struggle of To-day: Prof. H. S. Foxwell.

MATHEMATICAL SOCIETY, at 5.30.

LINNEAN SOCIETY, at 5.—The Heterangiums of the British Coal Measures: Dr. D. H. Scott.—Hypophysis and Premandibular Cavities; a Suggestion. E. S. Goodrich.—Wooden Scratching Tools made by an African Parrot: Miss N. Layard.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.—Stope Measurement at Messina: W. Whyte.—Platinum in Spain: F. Gillman.

FRIDAY, APRIL 20.

ROYAL INSTITUTION, at 5.30.—The Future of Wheat-growing in England: Prof. R. H. Biffen.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Presidential Address: M. Longridge.

SATURDAY, APRIL 21.

ROYAL INSTITUTION, at 3.—Aerial Navigation: Prof. G. H. Bryan.

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THURSDAY, APRIL 19, 1917.

EDUCATION AND RESEARCH.

Science and the Nation. Essays by Cambridge Graduates, with an Introduction by the Rt. Hon. Lord Moulton. Edited by Prof. A. C. Seward. (Cambridge: At the University Press, 1917.) Price 5s. net.

IT is the fate of many symposia to fail as a whole by the very excellence of the parts; relationship and proximity as well as stars are needed to form a constellation; and this unsatisfactoriness of *ensemble* is all too manifest in this well-intentioned volume that the Master of Downing has gathered together rather than edited, to which Lord Moulton contributes an introduction. Individually the chapters are of the utmost interest to the general reader; they give him compactly and authoritatively a sound idea of the scope and value of contemporary work in chemistry, physics, botany, geology, medicine, mathematics, and anthropology by such eminent Cambridge hands as Profs. Pope, Bragg, Hobson, Biffen, Wood, Nuttall, and Gowland Hopkins; and it is only when his heart, glowing responsively, demands, "And in return for all these benefits, in a lively hope of more to come, in the desire for more to come, what do you want the general public to do for you?" that the book becomes ineffective. This is not for want of a common intention. There are clear indications of a common intention to cry up "pure" science and to insist upon the importance of scientific studies and scientific research, but the cry never becomes more than a vague cry, and the need of the present time is for definite proposals. The present reviewer, who is a journalist very anxious for the advancement of science and very eager to serve it if he can, turns from this book with an uncomfortable sense that scientific men have still to develop a definite policy with regard to schools and colleges and higher education. They do not seem to realise how far science progress is bound up with these matters.

Here, for example, is a passage from Prof. Keeble's contribution. It shows an extraordinary blindness to the difficulties of the educational conflict at the present time. To the keen parent of promising boys, or to the keen patriot in these urgent times, its easy, ill-informed carelessness will be almost maddening.

> In our own sphere we might well make a beginning by calling a friendly truce between the big-endians and little-endians of Classics and Science. For if the protagonists were to confer instead of to contend, they would discover that in the ample years of leisure which our youth enjoy there is room in plenty for both classical and scientific education. In such a spirit of sweet reasonableness the scientific and the classico-clerical might proceed together to a reform of our system of education—from top to bottom. There is room for it. It is essential that our statesmen and administrators, our teachers and our poets, know something of the work and method and beauty of science. It is no less essential that the men of science of the coming generation should be cultivated citizens as well as competent specialists.

The Master of Downing failed in his editorial duty when he let that passage stand. No parent, no schoolmaster of any intelligence will endorse Prof. Keeble's delusion that the swift years of youth are "ample years of leisure." From first to last through the whole curriculum the educationist knows that he is up against an inexorable limitation of time. The contemporary dispute in education turns wholly upon the compulsory imposition of the Greek language upon those who go on to a higher education and upon its use as a medium of philosophical instruction. The case of the moderns is that *there is no time for Greek*, and that the Greek shibboleth cuts off philosophical studies from the general intelligence. No one anywhere is attempting to turn education into a manufacture of "competent specialists," and the idea Prof. Keeble favours, that to be cultivated and to be scientific are antagonistic states, is a suggestion of the enemy that has no real foundation in experience. A man may be a Greek scholar and a boor. A man may be unable to construe half a dozen words in Greek and have a beautifully trained and subtly refined intelligence. The case for the defence of the Greek obstacle consists largely in ignoring these facts.

If scientific men who have not had the time to follow up this educational controversy closely wish to grasp its essential values, they cannot do better than weigh over the implications of this passage that follows, from an article by Lord Bryce in the current *Fortnightly Review*:—

> I do not contend that the study of the ancients is to be imposed on all, or even on the bulk, of those who remain at school till eighteen, or on most of those who enter a university. It is generally admitted that at the universities the present system cannot be maintained. Even of those who enter Oxford or Cambridge, many have not the capacity or the taste to make it worth while for them to devote much time there to Greek and Latin. The real practical problem for all our universities is this: How are we to find means by which the study, while dropped for those who will never make much of it, may be retained, and for ever securely maintained, for that percentage of our youth, be it 20 or 30 per cent. or be it more, who will draw sufficient mental nourishment and stimulus from the study to make it an effective factor in their intellectual growth and an unceasing spring of enjoyment through the rest of life? This part of our youth has an importance for the nation not to be measured by its numbers. It is on the best minds that the strength of a nation depends, and more than half of these will find their proper province in letters and history. It is by the best minds that nations win and retain leadership. No pains can be too great that are spent on developing such minds to the finest point of efficiency.
>
> We shall effect a saving if we drop that study of the ancient languages in the case of those who, after a trial, show no aptitude for them.

Let the scientific man read that over carefully, and, if need be, re-read it. Let him note first the invincible conceit of the classical scholar in

the superiority of his particular education to any other, and his firm determination *to secure the pick of the available boys and the pick of the administrative posts* for the classical training. Science and research are to have those rejected as unfit in this sublime progress of the elect. Instead of our boys—I mean the boys destined for real philosophy, living literatures, science, and the study of actual social and political questions—having a straightforward, well-planned school course, they are to be *tried over* at Greek for just the most precious years educationally, and our modern world is to have the broken fragments. This claim is pressed even more impudently by Mr. Livingstone in his recent "Defence of Classical Education." He insists that all our sons are to be muddled about with by the teachers of Greek up to at least the opening of the university stage, entirely in the interests of Greek scholarship. Prof. Keeble's dream of "sweet reasonableness" is a mere dream. These classical people are absolutely ignorant of their own limitations; they can imagine no compromise; they mean to ram compulsory Greek down the throat of every able English boy they can catch, and they mean to load the scales in favour of Greek at any cost to science, philosophy, and national well-being.

Against this strangle-grip of the classic-worshipping mandarins on our higher English education such a book as "Science and the Nation" scarcely fights at all. Is it too much to suggest that scientific men should take a little more trouble collectively than they have hitherto done to master the essentials of this question, and to understand better what it is that really sustains the general contempt and distrust of modern knowledge in Great Britain and blocks the way to a widespread national support of research?

H. G. Wells.

THE WORLD CRISIS AND AFTER.

Janus and Vesta: a Study of the World Crisis and After. By Benchara Branford. Pp. xviii + 316. (London: Chatto and Windus, 1916.) Price 6s. net.

THIS is not a "war book," but it makes a well-timed appearance, for in an England unillumined and unchastened by these last terrible years it might have found few readers capable of perceiving its value. The author should now, however, be assured of a large company who will accept his invitation to read his work "backwards and forwards in the belief that it will repay careful study." To one at least who has done so it seems a noble book, full of a wise and strong humanity; worthy to be classed with writings to which all men pay homage. Any scientific reader who will start with the chapter on "Science and Occupation" and follow whither the clue leads will probably reach much the same opinion.

Mr. Branford is well known in the educational world as a divisional inspector of the London County Council. He was once a lecturer on mathematics in the Victoria University, and was afterwards principal of the Technical College and Director of Education in the Borough of Sunderland. In 1908 he published an admirable "Study of Mathematical Education," which has been translated into German. In 1902, in conjunction with Prof. W. A. Bone, he issued proposals for a school of metallurgy, which recent unhappy experiences have shown to be as necessary as they were far-sighted. The statement of these facts will suffice to commend to scientific readers the views on educational reform that constitute a vital part of the present work; it should, nevertheless, be added that the author deals with all aspects of the problem of education with quite remarkable insight and breadth of sympathy. His zeal for universal vocational training is the expression of no narrow ideal of "national efficiency," but springs from a profound study of the conditions of development of the human spirit. It is, therefore, in complete harmony with his passionate conviction that a revival of university life (including a renaissance of the "wandering scholar") is one of the most urgent needs of the time, being necessary in order that the nations, old and young, may not only rise to the full height of their spiritual possibilities, but also learn, through the intercourse and mutual understanding of their best minds, to compose their historical discords.

In this connection Mr. Branford argues with much force that universities have, during the modern epoch, largely forgotten their catholic mission, and have become, in many insidious ways, organs for the cultivation of national separatism and egotism. As a remedy for this state of things he presses the suggestion of a "world university," neutral, as the Papacy is neutral, to be the guardian of the common spiritual interests of mankind, both Western and Eastern, as the Papacy was formerly the guardian of the common spiritual interests of the western European nations.

It is not possible in a short notice to follow in detail Mr. Branford's diagnosis of the diseases of our age, or to indicate the remedies he proposes. It must be enough to say that whether he speaks of things temporal or things spiritual, his voice has the authentic accent of the prophet. Like all true prophets, he shows not only the eager desire to know the things that belong to the peace of his own people, but also the depth of vision that reveals them *sub specie aeternitatis.* For this reason, though his ideas are often at first provocative, they are generally seen, on candid consideration, to be widely and solidly based. No one concerned with the problems of our State, internal or external, can afford to neglect them.

SCIENTIFIC OBSERVATION AND REASONING.

Comptes Rendus of Observation and Reasoning. By J. Y. Buchanan. Pp. xl + 452. (Cambridge: At the University Press, 1917.) Price 7s. 6d. net.

MR. BUCHANAN is a believer in original research in the full significance of the words, including originality in methods and point

of view, as well as in the subject dealt with. Unlike his former volume of collected oceanographical papers, this collection consists of a selection on many subjects, scientific and popular, several reproduced from the pages of Nature. The strictly scientific memoirs deal with the relation of ice and brine, steam and brine, calorimetry, and the occurrence of ice in Nature, mainly in the form of glaciers. These researches grew out of Mr. Buchanan's observations of melting sea-ice during the cruise of the *Challenger* in the Antarctic regions, and, as regards calorimetry, in part out of observations on solar radiation during a solar eclipse in Egypt. The memoirs themselves form solid and informing reading for students; but they are rendered entertaining by the extraordinarily copious analytical Table of Contents, which occupies thirty pages. In this each paper is not only analysed and epitomised by the author, but also annotated, and sometimes criticised. For example, the discussion (reprinted from Nature, vol. lxix., p. 293) of the system of the Royal Society (and, for that matter, of all scientific societies) of referring the papers of fellows to unnamed referees, who may suggest or insert alterations, is illustrated by a delightful reminiscence. In explaining how they manage these things better in France, Mr. Buchanan gives this pleasing picture of an episode of his student days:—

"In the summer of 1867, while working in the laboratory of Wurtz in the Ecole de Médecine in Paris, I made some investigations on the products of the reaction of perchloride of phosphorus on salts of isethionic acid. I collected the results in a short paper, and, with Wurtz's approval, I proposed to offer it to the Academy. At that date Wurtz himself was not yet 'of the Institute,' but there was a standing custom that papers by his *élèves* were presented by Balard, the veteran discoverer of bromine. Accordingly, I took my paper with me and made a formal call on M. Balard, who received me with the greatest kindness and courtesy in his study, wearing, as had been the fashion in his younger days, a black frock-coat, and a white neckcloth taken twice round his neck. When I had expressed my desire that he would do me the honour to present my paper to the Academy, he replied at once that he would have the greatest pleasure in doing so. I handed him the paper, he presented it the following Monday, and it was published in the *Comptes rendus* of the next week."

Reference may be made to another annotated paper, the "Chemical and Physical Notes" which appeared originally in the "Antarctic Manual," prepared for Captain Scott's first expedition. These notes proved less useful than they should have been, as there was no trained chemist on the expedition, and the physicist who was appointed did not sail with the *Discovery*, and only joined her in Australia. Had there been a chemist of Mr. Buchanan's manipulative skill and keen insight the notes would have been most helpful, for he now tells us that he prepared them as memoranda for a worker by imagining that the worker was himself. In fact, we gather that they are the instructions which thirty years of experience had shown would have profited him most had he himself received them when he sailed on the *Challenger* in 1872. They will stand, we trust, as inspiration for the chemist of some future expedition. An interesting point about this paper is mentioned in the preface: "It was conveyed to me through an old friend and former colleague that this contribution to the 'Antarctic Manual' had done much to retard the standardisation of research. I took it as a compliment. To standardise research is to limit its freedom and to impede discovery. Originality and independence are the characteristics of genuine research, and it is stultified by the acceptance of standards and by the recognition of authority."

This expression of opinion is really a confession of faith, and Mr. Buchanan's consistent acceptance of it as a guide in his own work is apparent in every paper and article which he has written. It is one of the curious instances of history repeating itself, that in every age the really original thinker is treated as a heretic by organised bodies and conventional men, unless, or until, he can hold his own against all attempts at suppression, passive and active; then he becomes a prophet, whose disciples, in turn, exercise a like intolerance of the forerunners of the next advance.

H. R. M.

OUR BOOKSHELF.

A Practical Manual of Autogenous Welding (Oxy-Acetylene), with a Chapter on the Cutting of Metals with the Blowpipe. By R. Granjon and P. Rosemberg. Translated by D. Richardson. Fourth edition. Pp. xxii+244. (London: Charles Griffin and Co., Ltd., 1916.) Price 5s. net.

The fact that three large editions of this English translation have been exhausted in less than three years is evidence of the value it has been to those interested in the special technical methods described. Owing to the special nature of the subjects dealt with, the chief demands for the book must have arisen from workshops and factories where the processes so fully described are in actual use.

Although autogenous welding by means of the oxy-acetylene blowpipe has been largely used in this country, it has not received the same amount of attention as it has in other countries, such as France, for instance, where the Union de la Soudure Autogène has done valuable work in the encouragement of research and in the improvement of the methods of application.

The book deals with the properties and manufacture of oxygen and acetylene, and with the erection, testing, and working of welding installations; practical information is given on the composition of the metal welding rods and cleaning fluxes used, and on the preparation and execution of welds; and the autogenous welding of iron, steel, copper, brass, bronze, aluminium, and other metals and alloys is considered in detail.

A chapter is devoted to the important operation of cutting iron and steel by means of the blowpipe, in which illustrations of different types of cutting blowpipes are given, and the application of the process to new work, repairs, and demolitions is considered.

The book contains a large number of illustrations of practical value and can be very strongly recommended to all interested in the subject, especially as it contains a large amount of information not otherwise obtainable in the English language. C. O. Bannister.

Hawaiian Legends of Volcanoes (Mythology). Collected and translated from the Hawaiian by W. D. Westervelt. Pp. xv+205. (Boston, Mass.: Ellis Press; London: Constable and Co., Ltd., 1916.) Price 6s. net.

Many of us became first acquainted with Pele, the goddess of Kilauea, in the fascinating description of the Sandwich Islands by Miss Isabella Bird (Mrs. Bishop). The filaments of glassy lava, spun out by the wind from blobs thrown up into the air, have since become familiar to generations of students under the name of "Pele's hair." Mr. Westervelt now reveals Pele to us as a beautiful and wayward princess, warmly passionate, yet ready to consume her lovers, and dominating the long volcanic slopes with sheets and whirls of flame. The main interest of the legends lies in the evidence they provide of the constant and terrible menace under which the Hawaiians drew up their system of natural theology. The insistence on Pele's arrival from a distance suggests that the first settlers knew volcanoes elsewhere, but found Hawaii peaceful during their earliest years of occupation.

The author has illustrated his charmingly produced book by photographs of notable volcanoes, which greatly increase its attraction for the geologist, and include such rare scenes as the ideally shaped and snow-covered cone of Mount Shishaldin, in Alaska. Mont Pelée of Martinique (p. 160) recalls, by an odd coincidence, the name of the impulsive and beautiful devil of Hawaii. Humane anthropologists will take some comfort from Hii-aka-i-ka-poli-o-Pele, the youngest sister, who was literally incubated "in the bosom of Pele." G. A. J. C.

Fungoid and Insect Pests of the Farm. By F. R. Petherbridge. Pp. vi+174. (Cambridge: At the University Press, 1916.) Price 4s. net.

The author tells us this book has been written for those who wish to acquire some practical knowledge of farm and garden pests. It naturally does not aim at dealing with all the numerous enemies which affect crops, but rather at giving an accurate account of some of the commoner forms. It is a pity a great many more of the common pests were not included, especially amongst the Arthropods, for then it would have been of very considerably greater value. The accounts also of many of the pests treated in the book are far too short to be really helpful.

Part i. deals with fungoid diseases, including the potato disease, damping off, onion mildew, etc. Chap. iii. (pp. 35-47) describes the well-known finger-and-toe disease and the important wart disease of potatoes. In other chapters the author deals with mildews, ergot and clover sickness, rusts and smuts. Altogether nearly half the book is taken up with fungoid pests. A chapter is given on moths and butterflies, which deals almost entirely with the surface caterpillars. To the diamond-back moth five lines are devoted, in which one is told how to try to destroy it, without the slightest hint as to how to identify it. Wireworms and turnip-flea beetles (chap. x.) are better dealt with, and also the chafers; errors occur in the references to the figure here. The chief flies mentioned are the frit and gout flies, the Hessian fly, the cabbage-root flies, daddy-long-legs—the parents of leather-jackets—and the warble-flies. The last chapter deals with the eelworms, the accounts of which are far too short and vague to serve any useful purpose. There are fifty-four figures, most of which are good, but not nearly enough of the Arthropods for the book to be of much help to "those who wish to acquire some practical knowledge."

Fred. V. Theobald.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Adjustable Clock-dials.

To gain daylight by adjustment of the clock is a brilliant practical idea, but the present method of realising it by moving the hands of the clock is grossly unscientific, and should, I think, be changed for the alternative one.

Let the circular disc of the clock-dial be put in place by screws in curved slots. In spring and autumn, when changing time, we should rotate the dial backwards and forwards respectively, leaving the hands untouched. The advantages of this procedure are many:—

(1) The zenith and nadir of the sun are the natural turning-points in the day. These would still occur, as they should, at the *top* of the dial, though the time would then be one o'clock (for summer time).

(2) The times of rising and setting of the sun at the equinoxes are other natural points of time. These would occur, as they should, at the *bottom* of the dial.

One's concepts of time in the day are conditioned by the sun's movements, and the adjustment of the clock as here suggested would at least give pride of place to Nature's time signals; all the other points of time in the day could be varied without disturbance to one's instincts. As we are doing at present, the top and bottom of the clock are losing their special significance, and they mean one thing for several months and something different for the rest of the year.

(3) Some clock hands—*e.g.* in strikers—cannot be moved back. Hence in autumn we should avoid the painful necessity of standing by the clock during the

weary business of putting on the hands eleven hours and waiting for seventy or more strikes.

(4) When the clock is thus adjusted, one would see at a glance whether "summer" or normal time is being registered on his clock. At present we have no means of knowing from the clock itself which time is indicated.

Clock-makers might be well advised to initiate this simple change. I, for one, would certainly choose a clock of the type suggested, which, used as I urge, would obviously be less liable than on the present plan to injury at the bi-yearly adjustment.

P. E. SHAW.

AEROPLANES AND PROPELLERS.[1]

(1) CONTRARY to its title, the first quarter of Lieut. Turner's book is devoted to the aircraft of yesterday. The early mythical attempted or pretended flights attributed to such historical characters as Leonardo da Vinci, Dante of Perugia, Besnier, Barthelémy Lourenco, and others have always afforded entertaining reading. A book which starts with these exploits and traces the development of the airship and aeroplane past Montgolfier's discovery of the balloon and the aeroplane experiments of Lilienthal, Pilcher, Chanute, and Wright down to the present war cannot fail to be of interest.

It may safely be said that the author has been very successful in an attempt to concentrate the maximum amount of information in the minimum amount of space. Every page is full of facts, yet the book is quite readable and interesting. Much of the subject-matter will probably be new even to the great majority of experts; for instance, the altitude charts of the first historic balloon journeys from London to Russia and Sweden. The chapter on meteorology, too, contains a number of interesting tables of statistics relating to atmospheric conditions at different altitudes.

Modern aeronautical theory and practice may be said to occupy about 130 pages of the whole book, and this section contains interesting chapters on "Learning to Fly," "Sensations during Flying," and "Sensations during Ballooning." The remainder of the book is mainly taken up with aircraft in war, and undoubtedly will do much to enlighten the British public on matters which everyone ought to know. For example, on p. 242:—

"In anti-aircraft weapons Germany led the way and had done so for many years. The French were, however, in a strong position when the war broke out. Great Britain had done little save feed on illusion until a few months before the war, and for many months after deficiency in this respect was only too conspicuous."

But the most notable feature of this section is the chronicle of thrilling feats and adventures in the great war. Bomb-dropping on railways and on submarines, duels in the air, and seaplane adventures give some idea of the more exciting contents of the book, while, on the other hand, the possibilities and limitations of aircraft in war are subjects on which the author expresses well-considered opinions.

An intelligent reader would not, naturally, turn to a book of such a character for information on the more theoretical aspects of aeronautics. It is, however, to be regretted that the few references to the principles of mechanical flight are so fragmentary and one-sided that it would have been far better to leave them out altogether.

The constantly recurring references to stability cause that subject to assume an exaggerated degree of importance for which there is no historical justification, since inherent stability has played no part whatever in the practical evolution of the aeroplane except in its most recent improvements. Moreover, the definition of stability (p. 299) is incorrect, and on p. 159 Mr. Turner confuses the centre of pressure with the area of maximum pressure. On the other hand, the author fails to appreciate the fundamental importance of Langley's work in showing that for small angles of attack the air-pressure on an oblique lamina is far in excess of what it would be according to Newton's hypothesis. Had it not been for "Langley's law" modern feats of aviation would have been impossible. The next step was the improvement of light motors and propellers, on both of which subjects fuller statistical information would be of much more use than these scrappy attempts to discuss a highly technical question like stability. Moreover, we greatly doubt whether the systems figured as illustrating "inherent stability" have ever been proved to satisfy the requisite conditions. Many of them were certainly designed long before the experiments at the National Physical Laboratory rendered any such test possible.

These remarks apply in particular to certain systems on the type of the "Dunne" aeroplane, in which the angle of attack is negative at the tips of the wings. These *may* very probably be inherently stable, but the performance of a circular flight without touching the controls is no test of this property; sometimes the reverse. What is, however, evident is that the main effect of such an arrangement is to reduce the tendency to excessive banking in turning curves, and Mr. Bairstow, writing in the *Aeronautical Journal*, has expressed the view that a machine which turns without banking is unnecessary and undesirable from practical considerations.

A very short concluding chapter deals with "Flying Developments in Sight." It is interesting that no opportunity has yet arisen for testing the uses of the aeroplane in peace times. One application suggested by Mr. Turner is certainly promising, namely, exploration of unknown countries, and, in addition to the list of places which he mentions, we may not improbably live to see frequent air excursions to an hotel at the North Pole!

(2) M. Paul Popovatz's paper on "Reaction Apparatus" deals only with considerations of the

[1] (1) "Aircraft of To-day: a Popular Account of the Conquest of the Air." By Lieut. C. C. Turner. Pp. 315. (London: Seeley, Service and Co., Ltd., 1917.) Price 5s. net.
(2) "Notions générales sur les Appareils à Réaction." Par Paul Popovatz. Pp. 36. (Paris: Gauthier-Villars, n.d.)

most elementary character relating to propulsion by recoil, and in particular to the action of screw or other propellers when kept fixed relative to the surrounding medium. It is thus based entirely on the principles of momentum and energy, and the formulæ given are all immediately intelligible to any beginner who has mastered the somewhat illogical notation, according to which, when a mathematician speaks of ab, he means a *multiplied* by b. Of course, the amount of information thus obtainable regarding the behaviour of such a complex mechanism as an air-screw is comparatively small. The author makes his formulæ depend, amongst other things, on the mean velocity of the issuing-jet, its mass per unit time, and the area or diameter of the final

1. A Maurice Farman bip'ane with 70 h.p. Renault engine. 2. The Nieuport two-seater monoplane, generally fitted with an 80 h.p. Gnome. 3. The 80 h.p. Blériot "tandem" two-seater. 4. A Deperdussin monoplane. 5 The Henri Farman biplane, 80 h.p. Gnome. 6. A D.F.W. biplane, usually driven by 100 h.p. Mercédès engines. 7. An Ago biplane. 8. A Rumpler-Etrich Taube, 120 h.p. Austrian-Daimler engine. 9. An early L.V.G biplane, 100 h.p. Mercédès engine. 10. A B.E. 2*b* biplane, a product of the Royal Aircraft Factory, resembling the B.E. 2, and preceding the B.E. 2*c*. 11. A Morane "Parasol" monoplane. This machine is usually fitted with an 80 h.p Le Rhone motor. 12. A Bristol "Scout" biplane, fitted with a 100 h.p. monosoupape Gnome. 13. A German three-seater "battle-aeroplane." 14 A Henri Farman version of the Voisin, a steel biplane. 15. A standard straight-winged Aviatik biplane. 16. A modern Albatross biplane. 17. A German two-fuselage, double engined biplane. 18. The Martinsyde single-seater scout biplane. 19. Vickers gun-carrier, driven by 100 h p. Gnome. 20. Blériot armoured monoplane. 21. A two-engined Caudron biplane. 22. Morane monoplane, with Hotchkiss gun firing through the propeller. 23. Voisin gun-carrier. 24. Eighty h.p. Avro biplane. 25. A Maurice Farman of the "short-horn" type. 26. A Fokker biplane scout. 27. A Nieuport biplane scout with gun firing upward through the top plane. 28. A Taube. 29. A kite-balloon. From "Aircraft of To-day."

section. These are all quantities of which the assumed values have to be found experimentally, and one assumption, according to Renard's results, is that the final diameter of the section is equal to the diameter of an air-screw. The method certainly leads to one class of conclusions, namely, those deducible by means of the principle of similitude. For the rest, the most useful feature appears to be that the paper can be read by a mechanic having no knowledge of mathematics and very little knowledge of dynamics.

RESEARCHES ON CEREBRO-SPINAL FEVER.

IN January, 1915, the Medical Research Committee was consulted by the Director-General, Army Medical Service, with regard to an outbreak of cerebro-spinal fever which had occurred among the troops at home. Steps were at once taken to provide for the application of preventive measures, and also for organised research work to improve our knowledge by which further administrative action should be guided. Dr. Mervyn Gordon was appointed by the committee as bacteriologist to advise and superintend the scientific work; with him several other observers collaborated. A special advisory committee analysed the various studies then completed, and their report was published in January, 1916. The present publication[1] contains the reports received from Lieut.-Col. Gordon and his co-workers, and two other reports upon closely related work.

Cerebro-spinal fever is a disease which varies greatly in its clinical aspect in different cases. A minute spherical bacterium, the meningococcus, attacks the membranes of the brain and spinal cord, causing inflammation, and the definite recognition of the disease is finally based upon the finding of this organism in the cerebro-spinal fluid. The meningococcus also occurs in the naso-pharynx of a certain proportion of contacts and well persons, constituting "carriers," by whom the disease may be spread, and an important branch of all preventive measures is the searching out and segregation of such carriers, the identification of whom is similarly based upon the finding of the meningococcus in the naso-pharynx.

In the first paper of the present report Lieut.-Col. Gordon outlines the bacteriological measures taken to deal with the military outbreak of 1915. In the second paper, by the same observer, the discrimination of the meningococcus by means of agglutination is described. If an emulsion of a microbe be mixed with blood-serum derived from

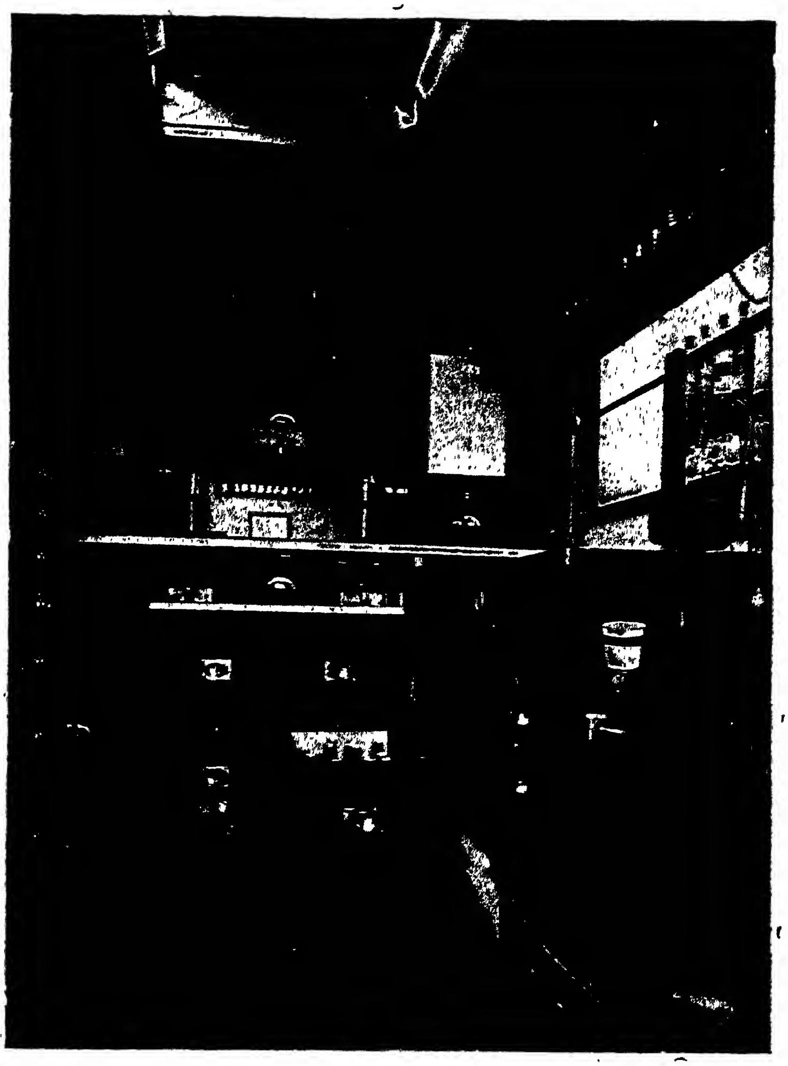

FIG. 1.—Interior of the Motor Laboratory.

an animal, *e.g.* a rabbit, which has received three or four injections of the microbe in question, the microbial cells in the emulsion generally aggregate into masses; this is known as "agglutination." The reaction is very specific, the serum of an untreated rabbit or of a rabbit injected with other species of microbes failing to agglutinate, so that an agglutinating serum is employed for discriminating species of micro-organisms. By means of this test the meningococci of the

[1] National Health Insurance. Medical Research Committee. Special Report Series, No. 3. Bacteriological Studies in the Pathology and Preventive Control of Cerebro-spinal Fever among the Forces during 1915 and 1916.

epidemic can be divided into four types (? varieties or species). The procedure was as follows: A series of meningococci from thirty-two cases of cerebro-spinal fever was collected, a rabbit was immunised with the first of them, and the agglutinating power of its serum tested upon all of them, with the result that nineteen of the strains showed good agglutination and the remaining thirteen slight agglutination or none at all. A second rabbit was then immunised with the first of these thirteen meningococci negative to the first serum, and agglutination tests made with all the thirty-two strains; eight of the cocci agglutinised well. A third rabbit was similarly prepared with one of the remaining five cocci, and four of the strains reacted, leaving one strain which had failed to react with the three serums. A fourth rabbit was prepared with this strain, and the serum tested on all the thirty-two strains; the homologous coccus alone was agglutinated, but none of the others. By the use of this test it has been found that only one type of meningococcus exists in a particular case of the disease or in a carrier, and the types have been found to remain quite stable and unaltered for a year.

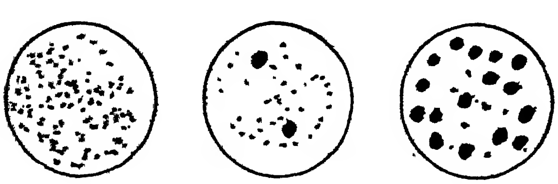

FIG. 2.—The fine dots represent colonies of salivary bacteria; the heavy dots represent colonies of meningococcus.

Capt. Flack contributes an exhaustive analysis on cases of cerebro-spinal fever in the London district. Lieut.-Col. Gordon and Capt. Flack detail experiments on the attempt to disinfect carriers. Chloramine-T in the form of spray was found to be the most efficient agent, and carriers with a scanty infection clear up quickly under its influence, but cases with an abundant infection are far more difficult to "cure."

Major Hine describes the organisation of a supply department of the Central Laboratory for furnishing media and other requisites for the bacteriological examination of cases and contacts. A motor laboratory was used in this connection (Fig. 1); it contained working bench, water supply, incubators, etc., all the equipment necessary for investigating cases on the spot.

In a final paper Lieut.-Col. Gordon describes the inhibitory action of saliva upon the growth of the meningococcus. It was found that meningococci mixed with saliva fail to grow on appropriate media. If the saliva be diluted more and more, a stage is reached when the meningococci begin to grow, and as dilution proceeds the meningococci are finally unaffected (Fig. 2).

This action of saliva in inhibiting the growth of the meningococcus was found to depend upon the presence of the salivary micro-organisms, for if the saliva be centrifuged so as to get rid of these it no longer inhibits.

From this brief and incomplete summary it will be seen that the report contains matter of considerable interest to the bacteriologist and epidemiologist which should be of much value in the control of cerebro-spinal fever in the future.

R. T. HEWLETT.

NOTES.

THE annual meeting of the British Science Guild will be held at the Mansion House on Monday, April 30, at four p.m. The Lord Mayor will preside, and an address on "National Reconstruction" will be given by Lord Sydenham. Other speakers will be Sir William Mather, Mr. H. A. L. Fisher, President of the Board of Education, and Mr. H. G. Wells. Admission will be by ticket, to be obtained from the secretary, British Science Guild, 199 Piccadilly, London, W.1.

IT is a common conceit among representatives of literary studies that attention to the natural sciences in educational courses is detrimental to the development of the noblest attributes of civilised life, and tends to produce a non-moral condition of mind. With complete disregard of the historical meaning of the "humanities," they use this term to signify such subjects as languages, literature, and history, in contradistinction to a dehumanised study which they classify as "science." Writers in the public Press may perhaps be forgiven a want of understanding in this matter, but responsible leaders of thought should enlighten the popular mind instead of deluding it by misrepresentation. When, however, we read a communication from Prof. Ramsay Muir, professor of modern history in the University of Manchester, to a recent conference arranged by the Workers' Educational Association at Liverpool, we begin to wonder whether representatives of letters and history will ever understand what are the true aims and motives of science teaching. Prof. Muir is reported to have written: "I am mortally afraid of an over-emphasis upon natural science, especially in the teaching of children under sixteen. . . . What is likely to be the effect of concentrating all their attention upon the ruthless and non-moral laws of Nature? Something of the moral effects of this we have seen, I think, in Germany. The philosophy which has poisoned the national mind is a philosophy which tries to transfer the concepts and ideas of science to human life." It is untrue that teaching children the elements of the natural sciences leads to ruthlessness and is dangerous to civilisation, and the suggestion that German barbarity is the result of such teaching has its origin, not in fact, but in prejudice. The historians, moral philosophers, statesmen, and diplomatists responsible for the war were not educated in scientific schools, but in the Gymnasien, where even less attention is given to science than in many of our public schools. The fact is that in our own schools there is already more science teaching than in any corresponding schools in Germany, and that if it leads to national degeneration, we should exhibit this character rather than the Germans. The attempt to father upon science the diabolical conduct of the war by our enemies is unworthy of literary learning, and a perversion of historical truth. Only an unscientific mind could lend itself to the expression of conclusions so little supported by evidence.

THE food problem is one of those matters in which everyone may help the State by action, and by bringing influence to bear on others. A most important

fact is the shortage of wheat in this country. Putting it very shortly, at our present rate of consumption of wheat we cannot get through until next harvest. It is everyone's duty to try to realise, and get others to realise, what it means to have this country without bread and potatoes for a month or six weeks. The result would be starvation, and the remedy is to eat one pound less of bread per week per person than we at present consume. Compulsory rationing is a thing to be avoided if possible; voluntary rationing may, when weighed in the balances, be found wanting. There is an intermediate course, which may be called "persuasive rationing." The distributors of flour are comparatively few in number. These might well be instructed to reduce in every way possible the flour sold by the amount required in the above-mentioned scheme. The baker in turn should be advised and encouraged to persuade each individual customer to cut down his weekly bread allowance by the pound a week suggested. In order to make this easy, the supplies of oatmeal, barley meal, maize meal, rice, etc., should be made readily accessible to the baker through millers and flour factors; the baker should be advised to prepare from these a cooked substitute for bread. Even if this had to be a biscuit, like the old-fashioned ship's biscuit, it would be eatable, and an efficient bread substitute. The average person does not like a helping of stewed rice when he wants a slice of bread, but a plain biscuit should be quite acceptable. The "persuasive" baker could then, while docking the bread allowance, offer instead the equivalent in the form of biscuits (or similar articles), other than of wheat, as an alternative. It is believed that this course would render it materially easier for the average individual to lessen his bread consumption.

At a meeting of the Aeronautical Institute on March 22, a paper by Col. B. R. Ward was presented, dealing with the means of securing the best supply of officers for the scientific services of the Army. The author urges that for the highest efficiency the Services must maintain contact with the civil professional organisations and a practical connection with the varied national work in engineering. The present war has demanded the utmost knowledge, experience, and energy from engineers in all branches of the profession. Engineers of all ranks have rendered invaluable services attached to the Army in the field, in workshops at the base, in constructing railways, in organising transport at home and abroad, and in advising Government departments. What the author most definitely suggests is that there should be a permanent corps of Mechanical Engineers, organised similarly to, and attached to, the Royal Engineers, capable of performing such functions and ready for any future emergency. The difficulty is that in peace-time there is not scope for the acquirement of the necessary varied experience within the range of military requirements. Col. Ward appears to think that the corps he proposes should in peace-time largely engage in civilian employment. There is something to be said for such a view. The earlier irrigation works in India were executed by Royal Engineer officers with great zeal and efficiency. But now public works there are carried out by a civilian department, it is believed with advantage to India. Engineering has become complex, and is best in the hands of men who devote their lives to it or to a special branch of it, and who are not hampered by military duties or regulations. Still, no doubt the war has shown defects of preparation, and something in the direction of Col. Ward's suggestions may be desirable.

By the death of Mr. Walter Baily, London, and in particular the University of London, has lost one who has played an important part in connection with education. From a report in the *Times* of April 3 we learn that after a brilliant academic career at Cambridge (Second Wrangler, Smith's prizeman, and fellow of St. John's College) he was appointed inspector of schools in the West Riding of Yorkshire. From 1893 to 1915 he was a member of the council (which, on the incorporation of the college in the University, became the committee) of University College, London, and from 1902 to 1906 the chairman of its committee of management. His scientific work reflected his early mathematical training, though it was combined with a keen interest in experimentation. The record of it is to be found mainly in the early volumes of the Proceedings of the Physical Society, of which he was for many years secretary, and afterwards a vice-president. One of the most interesting of his experimental researches consisted in a new mode of producing Arago's rotation. This is, in principle, an anticipation of the two-phase motor: two electromagnets with their poles beneath the Arago disc, and in planes at right angles to one another, having their polarity inverted by a commutator so that the fields have a phase difference of 90°. His other papers describe an integrating anemometer of his own design, the vibrations of a film in reference to the phoneidoscope, an illustration of the crossing of rays, a map of the world on Flamsteed's projection, a theorem relating to curved diffraction gratings, the construction of a colour map (in which he advocated the use of rectangular instead of trilinear co-ordinates), and a mathematical explanation of the appearances presented by starch and unannealed glass under the polariscope.

We regret to record the death at Washington, D.C., U.S.A., of Dr. Hamilton Wright at the age of forty-nine. While at Cambridge University and at the Pathological Laboratory of the L.C.C. Asylum, Claybury, Dr. Wright made investigations upon the nervous system, notably a number of experiments upon animals, with the view of demonstrating chromatolytic and dendritic changes in the neurones of the brain as a result of prolonged chloroform narcosis. He was next appointed by the Colonial Office to investigate beri-beri in the Straits Settlements, where he supervised the building and equipment of an excellent pathological laboratory at Kuala Lumpur. Here he conducted his researches on the causation of beri-beri. He came to the conclusion, both by experiments on animals and observations upon prisoners in the gaol, that the theory of rice being the source of the transmission of an organism to the human system was incorrect. In his report he states that "beri-beri is due to a specific organism which remains dormant in certain localities, but, having gained entrance to the body by the mouth, it multiplies locally (in the stomach or duodenum chiefly) and gives rise to a local lesion, and produces a toxin which, gaining the general circulation, acts on the peripheral terminations of both afferent and efferent neurones to cause bilateral symmetrical atrophy; and that finally the organism escapes in the fæces, to lie dormant again in places." Although the absence of the vitamine in polished rice is now the generally accepted theory of the causation of beri-beri, it does not exclude the possibility of a secondary microbial toxæmia acting as a coefficient. Dr. Hamilton Wright married the daughter of Senator Washburn, and took up work for the United States Government. He was appointed a member of the International Opium Commission, and prepared a Bill for the suppression of the opium trade, known as the Harrison Bill, which was passed by Congress.

During the Easter vacation the Port Erin Biological Station has been occupied by about twenty senior

women students and post-graduate researchers—most of them present or future science schoolmistresses taking a course of practical marine biology, under the direction of Prof. Herdman, Mr. Douglas Laurie, and Miss R. C. Bamber, and supported by a grant from the Liverpool Council of Education. The wintry conditions have been unfavourable for much work in the open, but plankton observations in the bay have been made almost daily, and the vernal maximum of the Phyto-plankton (mainly Coscinodiscus and Chætoceras spp. at present), which is probably affected more by the increasing sunlight than by temperature, is now (April 12) well marked. The fish-hatching is going on as usual, and several millions of young plaice have already been set free to the west of the Isle of Man. A point of considerable interest is that the second generation of young plaice reared in captivity is now passing through the hatching-boxes. There are about eighteen adult plaice reared from eggs produced and hatched in the tanks in the season of 1914, and therefore just three years old, which are now spawning. One of these fish, which has been isolated in an aquarium tank and is now producing spawn, measures 27 cm in length (about $10\frac{1}{2}$ in.). The average size of spawning female plaice in the Irish Sea is about 15 in., and the smallest previous record is about 13 in. The eggs produced from these three-year-old plaice are slightly smaller than those from older fish, but otherwise seem normal, and are developing into embryos and larvæ. A large shoal of grey mullet visited Port Erin Bay on April 11 and 12—a very unusual occurrence at this time of year—and swarmed close in to the rocks and beach at high tide. More than 400 large fish, some of them weighing up to 7 lb., were caught in a seine net and sent to the Liverpool market.

A COPY of an address by Prof. Murray Butler, delivered at the annual dinner of the Pittsburgh (Pa.) Chamber of Commerce on February 10 last, has been received. Prof. Butler asks, and attempts to answer, the question: "Is America Drifting?" The general tone of the address would probably have been modified had it been delivered after the entry of the United States into the war, but its appeal to thinking Americans to do all in their power to assist the adjustment of American national institutions to modern-day needs and demands could scarcely have been more insistent. "I do not recall," says Prof. Butler towards the end of his address, "that any great administrator has ever been chosen to be President of the United States, and few governors or mayors seem to take any interest in the improvement of ordinary administration, such as every manager of an industrial or business undertaking concerns himself with every day and every hour." Americans, he states, are so concerned with their own personal affairs and immediate interests that they are letting America drift, and until every American feels his personal responsibility for the formulation of definite public policy at home and abroad, and for the businesslike administration of public affairs, the drifting will continue. There is, he insists, a call to Americans for national service and a preparation for it which, so far from sharing the spirit of militarism, are only the voice of democracy conscious of its obligations and its duties, as well as of its rights and opportunities.

THE Società Italiana delle Scienze has awarded the gold medal of the physical section to Prof. W. H. Bragg and Mr. W. L. Bragg in recognition of their distinguished work in physics.

MR. T. SHEPPARD, curator of the Hull Municipal Museums, has been elected honorary life member of the Selby Scientific Society, in recognition of his services since the society was founded.

RECENT enterprises in connection with the preparation of food and the development of its concessions in West Africa and elsewhere have led to the establishment of a research department by the Co-operative Wholesale Society, and Dr. Geoffrey Martin has just been appointed to direct its work. This appointment marks a new departure in connection with the co-operative movement, and has been rendered necessary by the concessions acquired by the Co-operative Wholesale Society in West Africa, Nigeria, and elsewhere, as well as by the development of fresh undertakings at home.

THE National Canners' Association has offered Harvard University, says *Science*, the sum of 400*l.* annually for a period of three years to carry on an investigation of ptomaine poisoning, with special reference to canned goods. The offer has been accepted by the University, with the understanding that the investigation shall be conducted and the results published with entire academic freedom. The study will be made at the medical school, under the direction of Dr. M. J. Rosenau, professor of preventive medicine and hygiene. The National Research Council of the National Academy of Sciences is supervising the investigations on this subject.

THE *British Medical Journal* announces the death, on February 27, of Prof. J. J. Dejerine, of the University, Paris, one of the leaders of contemporary neurology. He was born at Geneva in 1849, and studied medicine in Paris, where he took his doctor's degree in 1879. In 1901 he was appointed professor of the history of medicine, and afterwards transferred to the chair of internal pathology. Finally, in 1911, he became professor of nervous diseases and head of the clinic at the Salpêtrière. He was a member of the Académie de Médecine, and an honorary fellow of the Royal Society of Medicine, which awarded him the Moxon medal. From the first he devoted himself to the study of neuro-pathology, and his published papers cover the whole field of nervous disease. His chief work is the "Anatomie des Centres Nerveux," written in collaboration with his wife, herself a doctor of medicine.

AT the fourth annual general meeting of the Institution of Petroleum Technologists, the elections were announced of Mr. C. Greenway as president, Prof. J. Cadman as a vice-president, and Sir Frederick Black and Major A. Cooper-Key as honorary members. The vice-presidents and council for the ensuing year are:—*Vice-Presidents:* The Rt. Hon. Viscount Cowdray of Cowdray, Sir Thomas H. Holland, and Sir Boverton Redwood, Bart.; *Council:* A. C. Adams, H. Allen, Sir Robert Balfour, Bart., Capt. R. W. Barnett, H. Barringer, Sir George Beilby, E. R. Blundstone, A. Campbell, J. T. Cargill, E. H. Cunningham Craig, A. W. Eastlake, T. C. Palmer, Dr. F. Mollwo Perkin, and R. Redwood.

IN Southern Nigeria the wholesale destruction of interesting cult-objects by the fanatical adherents of the prophet who called himself "Elijah II." has robbed ethnologists of a vast amount of valuable material which can never be replaced. It is fortunate that Mr. P. Amaury Talbot, while engaged in official work in these districts, has been able to form a splendid collection of ethnological specimens, and both the British Museum and the Oxford Museum have acquired by his generosity a number of valuable accessions. Among them Mr. Henry Balfour, in the April issue of *Man*, describes a remarkable carved and painted ceremonial paddle used by the Kalabari tribe.

This formed part of the paraphernalia of the amaningiu, or serpent, Juju, the serpent and the hippopotamus spirit being represented on Janus-like carvings on the back and front. A similar rendering appears on a Kalabari wooden mask from Abonnema, which is also described in this article by Mr. Henry Balfour.

In the Journal of the Royal Anthropological Institute (vol. xlvi., July–December, 1916) Dr. Bronislaw Malinowski contributes a paper on "Baloma: The Spirits of the Dead in the Trobriand Islands," which lie off the eastern coast of British New Guinea. Incidentally, he discusses the question, brought into prominence by Spencer and Gillen in the case of the Australian Arunta, that the belief in reincarnation, a spirit child believed to enter the womb of the mother, excludes any knowledge of the physiological law of the process of impregnation. That this ignorance exists is certain. The writer deals with this difficult subject in a scientific and tactful way, and he arrives at the general conclusion that its prevalence among the Melanesians of New Guinea is a condition extending into much higher stages of development than it would have seemed possible to assume only on the basis of the Australian material.

The *rôle* of the flagellated protozoa in infective processes of the intestines and liver (of animals) is the subject of Bulletin 166, Agricultural Experiment Station of the Rhode Island State College, U.S.A., by Dr. P. B. Hadley. Evidence is presented that a Trichomonas is the causative organism of an almost invariably fatal cecal and hepatic infection in birds. The pathological findings are described and the course of infection and development of the parasite is studied. The paper is illustrated by three excellent plates. In a further Bulletin (No. 168) the avenue and the development of tissue infection in intestinal trichomoniasis are discussed. The stages are, first, multiplication of the parasite in the cecal contents, then the flagellates penetrate the goblet cells of the intestinal mucous membrane, break through the basement membrane of the mucosa, and enter the sub-mucous connective tissue. Simultaneously, a marked invasion of the base of the crypts occurs, and the crypt space becomes consolidated. As a result of this, the deep-lying cecal epithelium becomes to a large extent destroyed. Eleven plates illustrate this part of the investigation.

The *Quarterly Journal of Experimental Physiology* for March (vol. x., Nos. 3 and 4) contains a series of papers by Prof. Noel Paton and Messrs. Findlay, Watson, Burns, Sharpe, and Wishart on the functions of the parathyroid glands and their relation to the disease known as tetany. It is shown that removal of the parathyroids induces a condition resembling tetany. This effect is brought about by the influence of the parathyroids on guanidin and methylguanidin metabolism; these substances are increased in amount by removal of the parathyroids, and their artificial administration induces a condition resembling tetany. Tetany may therefore be regarded as being caused by an increase in the amount of guanidin and methylguanidin in the body, due to disease or disordered function of the parathyroids.

In *California Fish and Game* for January a long and valuable history is given of the introduction of food and game fishes into the waters of California. The author, Mr. W. H. Shebley, who is in charge of the fish-culture department of the California Fish and Game Commission, carries his survey from the initiation of this work in 1871 to the present day. While he has many failures to record, as must always be the case in acclimatisation work, he has a long list of very striking successes. Among these are to be reckoned the introduction of the common shad. Between 1871 and 1880 as many as 619,000 shad fry were imported from the Castleton hatchery in New York and turned down in the Sacramento River. As a result, this fish is now one of the commonest in Californian waters. The introduction of carp, "which will probably become one of the State's most valuable food fishes," has been equally successful, though it has brought about the destruction of the Californian perch. As a set-off against this, however, it is pointed out, it forms the chief food of the black and striped bass. The introduction of the black bass into California is regarded as "one of the greatest feats of acclimatisation of new species of fish in the history of fish-culture." Loch Leven trout have also thriven. The introduction of the carp, we note, has given cause for repentance in one case, at any rate. Their rapid increase in the Chautauqua Lake so fouled the water as to make it almost unfit for use. In consequence, pike and muskelunge were introduced to exterminate the carp, but the latter still remain in possession, the fish introduced to effect the work of extermination having themselves been exterminated. An excellent coloured plate of the eastern brook-trout forms the frontispiece of this number.

As a result of the shortage of cotton owing to the war, we learn from "Am Haüslichen Herd" (Zürich, Pestalozzigesellschaft, xx., 6) that an old industry is being revived in the cultivation of stinging nettles for textile purposes, both in Switzerland and Germany. In order to obtain fibres of the best quality, the nettles should be grown on rich soil and thinned out when necessary. In the spring, when they are about a foot high, they are to be cut down and the young tops may be eaten like spinach. The second growth produces much better fibres than the first, and the stems are cut down in June or July, when they have reached a height of about 4 ft. Another crop is obtainable in September. In October the shoots can be used as fodder, and for this purpose they may be dried, when they will lose their stinging properties. They may also be chopped up for feeding poultry. It is much to be hoped that in our country a similar use will be made of the stinging nettles, which at present constitute such a pest in gardens and plantations.

On the basis of Bohr's theory, taking account of the magnetic and electrical fields of the atom, a general formula for spectral series has been deduced by Mr. J. Ishiwara (Proc. Tokyo Math. Phys. Soc., series 2, vol. ix., No. 2). The formula may be written:—

$$\nu = A - \frac{\alpha}{(m+\mu)^2[1+a(A-\nu)+b(A-\nu)^2]^2} - \frac{\sigma\alpha}{(m+\mu)^4}$$

where ν gives the wave numbers of lines corresponding to successive integral values of m, A is the limit of the series, and α is the Rydberg constant, slightly varied according to the atomic weight of the element; μ, a, and b are constants special to each series. The last term is a relativity correction, and σ has the numerical value 0·00015908. As a test of the formula, the author has employed it in a re-calculation of the numerous series of enhanced lines of magnesium discovered by Fowler, for which the Rydberg constant has four times the value appropriate to the arc lines. The formula appears to be well adapted to the series in question, and there are some curious relations between the values of μ for six of the series.

On behalf of the Bureau of Standards, Dr. G. K. Burgess, the head of the metallurgical department of

the bureau, has recently made a series of observations at steel works in the United States with the object of determining the best methods to use in the measurement of the temperatures in Bessemer and open-hearth practice. He finds that the present methods involve differences of temperature between consecutive Bessemer teems and between successive melts in the open-hearth furnace which may exceed 50° C., and strongly advises the use of some form of optical pyrometer using monochromatic light, in order to introduce greater certainty in the conditions which determine the properties of the steel produced. In the complete paper, which is to be issued by the bureau, details of the methods adopted are to be given. At present information is available in abstract only in the Transactions of the American Institute of Mining Engineers, before whom Dr. Burgess gave an account of his work at the New York meeting in February.

Prof. McAdie, the director of Blue Hill Observatory, proposes a new temperature scale in which the freezing point of water is to be taken as 1000, and the absolute zero −273° C., as 0. He points out the objections to the present scales; and the suggested scale, if we could make a new start, would certainly have some advantages. For meteorological purposes the Centigrade degree is too large, since it is possible to express mean values of temperature with accuracy to within a few tenths of a degree, and a difference of 1° C. in the mean summer temperature of a place, for example, makes quite an appreciable difference in the climate; but a quarter of this, about 1 on the suggested scale, would not be appreciable, so that it would suffice on it to express values to the nearest whole degree. The advantage of starting from the absolute zero is very great, especially to those who have to deal with radiation and to artillerists or airmen, who are concerned with the density of the upper strata, but the suggested scale would involve the printing of four figures, which is one too many.

From an article contributed by M. Renouard to *La Nature* of March 31 it appears that in France the metric system has not yet ousted all the old customary denominations of measure in many trades, especially those connected with the textile industry. For example, in the hosiery trade, sizes of stockings for children are indicated in terms of the old Paris inch, while the numbers denoting the lengths of ready-made articles for grown-up people relate to the same ancient measure: thus, size "36" signifies a length of 36 in. Again, in the north of France the widths of cloths and linens are denoted by such fractions as 2/3, 4/4, 7/8, the widths being the corresponding fractions of the "aune" of 120 centimetres. It is true that traders are not always aware of the origin of the symbols they employ, and there is an amusing instance of this in the case of certain silk stuffs invoiced "15/16," which some shopkeepers from ignorance have represented to their customers as "fifteenth- and sixteenth-century taffetas." Gold and silver fringes and ribbons are sold according to numbers which correspond to their widths in terms of the old Paris "line." Numerous examples of the persistence of ancient or foreign systems of measure occur also in the lace trade and in the numeration of silk and cotton yarns. Although so many anomalies still exist as regards measures, the old customary weights, on the other hand, appear to have been completely superseded in France by metric denominations.

The appearance of the decennial index of the *Biochemical Journal* induces us to make a mental review of the biological chemistry of recent years. Although first issued in 1907, it was not until five years later that this journal was taken over by the newly formed Biochemical Society, for which it has since been edited by Profs. W. M. Bayliss and A. Harden. According to the original idea, opportunities for chemists and biologists to forgather were to be provided by establishing a biochemical club. But the club, shortly after its foundation, was transformed, to the regret, perhaps, of many of its members, into the present Biochemical Society. This society was instituted for the purpose of facilitating intercourse between those biologists and chemists who are interested in the investigation of problems common to both. The title "Chemistry of the Living Organism," used in its widest sense, might perhaps be suggested to include all such problems. It will be acknowledged that the society has attained its object to a marked degree, and the index of the *Biochemical Journal* is a witness to the valuable work which has been accomplished by the society through its members. The names of nearly all the well-known workers in biological chemistry are to be found in this index, and the subjects of their labours range from the distribution of maltase in plants to the treatment of trypanosomiasis. Those who ever have occasion to refer to the literature of biological chemistry will certainly find this index a valuable adjunct to their libraries.

OUR ASTRONOMICAL COLUMN.

The Planet Mercury.—This object will be favourably visible to the naked eye on clear evenings during the remainder of the present month. Its light varies considerably owing to change of phase, but with good conditions the planet shines more strongly than a star of the first magnitude. About an hour after sunset it should be readily discerned above the W.N.W. horizon when the sky is clear. It will set as under:—

		h. m.			h. m.
April 19	...	9 1 p.m.	April 25	...	9 19 p.m
20	...	9 6	26	...	9 19
21	...	9 10	27	...	9 20
22	...	9 13	28	...	9 20
23	...	9 16	29	...	9 19
24	...	9 18	30	...	9 18

The planet will arrive at its greatest elongation on April 24, when it will set about 2h. 10m. after the sun. The above are Greenwich mean times; for summer time one hour must be added.

Comet 1917*a* (Mellish).—Prof. Strömgren has circulated the following revised elements and ephemeris, calculated by J. Braae and J. Fischer-Petersen from observations on March 21 (Lick), March 25 (Königstuhl), and March 30 (Copenhagen):—

$$T = 1917, \text{ April } 10{\cdot}6285 \text{ G.M.T.}$$

$$\left.\begin{aligned} \omega &= 120° \; 36{\cdot}73' \\ \Omega &= 87° \; 23{\cdot}77' \\ i &= 32° \; 23{\cdot}57' \end{aligned}\right\} 1917{\cdot}0$$

$$\log q = 9{\cdot}28448$$

Ephemeris: Greenwich Midnight.

1917	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ	Mag.
April 19	0 41 7	−1 26·9	9·5732	0·0132	5·2
21	44 32	3 7·8	9·6331	0·0340	5·6
23	48 31	4 28·9	9·6852	0·0529	6·0
25	52 47	5 35·5	9·7309	0·0701	6·3
27	0 57 9	6 31·3	9·7713	0·0858	6·6
29	1 1 31	7 19·1	9·8076	0·1002	6·8

Laboratory Work in Astrophysics.—An instructive account of the relation of laboratory investigations to astrophysical research has been given by Dr. A. S. King (Pub. Ast. Soc. Pacific, February). Apparatus

for physical investigations formed a large part of the equipment of observatories in which the earlier work in astrophysics was carried on, such as those of Lockyer and Huggins, and Dr. King points out that there is a constantly increasing demand for this close co-operation between the laboratory and the observatory. Though much work of great value has been done in university laboratories, greater continuity in the prosecution of extensive pieces of research is possible in a laboratory which is specially equipped, and provided with a staff having full time to devote to these problems. Typical examples of the experimental work carried on at Mount Wilson are described and illustrated; the photographs showing the effect of the magnetic field on the sun-spot spectrum are particularly striking.

PARALLAX OF A PLANETARY NEBULA.—In view of the doubtful value of most of the parallaxes previously deduced for nebulæ, a result recently obtained by Mr. A. van Maanen with the 60-in. reflector at Mount Wilson is of considerable interest and importance (Proc. Nat. Acad. Sci. Washington, vol. iii., p. 133). The nebula in question is N.G.C. 7662, having a sharp stellar nucleus which gave measurable images with exposures of twenty-five minutes. The absolute parallax is given as 0·023″, which would place the nebula at a distance of about 140 light-years. As the angular diameter of this nebula is 26″, its linear diameter would thus be of the order of nineteen times that of the orbit of Neptune.

THE RECENT COLD WEATHER.

AFTER a more than usually severe winter, the spring has opened with exceptional cold over the whole of Great Britain, and the wintry conditions have also embraced a large part of western Europe.

Dr. Mill, the director of the Rainfall Organisation, in a letter to the *Times* of April 11, mentions that "the first ten days of April have been colder this year than in any other," according to the Camden Square record of temperature, which has been kept for sixty years. Frost is said to have occurred on every night but two. In the Camden Town records for 1888 frost occurred every night but one, although the mean temperature for the period was slightly higher than in the present month. The Greenwich records for the past seventy-five years show that prior to the present year the greatest cold for the first ten days of April occurred in 1888, when the highest night temperature for the period was 32·1° on April 1. At South Kensington, the recording station of the Meteorological Office, frost occurred in the open on thirteen nights during the first fortnight of April this year.

The cold has been even more severe over the northern portions of the kingdom; and in the official reports from the health resorts, Southport is shown to have had a minimum shade temperature of 13° on April 3.

In the winter six months, from October to March inclusive, there was frost on seventy-three nights at Greenwich. During the last seventy-five years frost has only occurred more frequently in the six winter months six times, whilst the winter which has just closed has had a greater number of frosts than any winter since that of 1890–91, when there were seventy-six frosts. The highest number is eighty frosts, in the winter of 1887–88.

The frequency of snow in London is dealt with in the *Times* of April 11, and records by a meteorologist at Wandsworth Common for the last quarter of a century are referred to. Snow is said to have fallen on as many as thirty days this year prior to April 11, and since that date snow has fallen on four more days to April 17, so that snow has fallen on thirty-four days since the commencement of January. This is three times the average for the first four months of the year, and is eleven more than in any corresponding period since 1892. The average number of days with snow in an entire year at Wandsworth Common for the past twenty-five years is thirteen. Mr. Mossman, in a communication made to the Royal Meteorological Society some years ago, showed that the average number of days with snow was fifteen in the course of the year, deduced from the observation of 100 years, and twelve of these snowy days occurred in the first four months of the year.

Snow has fallen in larger quantities during the last few months over the northern portion of the kingdom than in the south, although the occurrence of the snow may not have been more frequent.

In 1908 railway traffic was much hampered in the south of England by a heavy fall of snow on April 25, and ordinary traffic by road was completely stopped for a time.

Rainfall for the past winter was less than in many recent winters, and the total for the six months in London was 14·4 in., which is about 110 per cent. of the average. January and February were dry, little more than one-half of the average rain falling in the latter month. Sunshine has been deficient for months past over England, and in London there has been an unusual number of overcast and sunless days.

CHAS. HARDING.

MEMORIAL TO SIR WILLIAM AND LADY HUGGINS.

ADDRESS BY SIR J. J. THOMSON, O.M., P.R.S.

WE gave on April 5 (p. 109) an account of the unveiling of a memorial to Sir William and Lady Huggins in St. Paul's Cathedral. The address delivered by Sir Joseph Thomson on that occasion has since reached us, and we are glad to be able to print it below.

I have been asked, as president of the Royal Society, to commit this memorial of Sir William and Lady Huggins to the care of the Dean and Chapter of St. Paul's, and also to say a few words as to the inception of the memorial. Shortly after the death of Sir William Huggins some of his friends were anxious to set on foot a proposal to obtain a memorial of him; this came to the knowledge of Lady Huggins, and she expressed the wish that she might be allowed to defray all the expenses, so that no one except herself should be put to any expense in the matter. Before any arrangements had been arrived at Lady Huggins died, and it was found that in her will she had left a sum of money to provide for a memorial to Sir William. It seemed to those responsible for carrying out her wishes that in view of the long and active part she had taken in her husband's work, and that some of the most important papers were published in their joint names, no memorial to Sir William would be satisfactory unless it testified in some way to the part Lady Huggins had played in his work; to effect this a small medallion of Lady Huggins had been added as a pendant to the one of Sir William.

There can be no question as to the claim of Sir William Huggins, the founder of astrophysics, as he has been called, to such a memorial, nor any doubt as to where it could most appropriately be placed. For no man of equal scientific eminence was ever more closely connected with this city. He was born in London, he was educated entirely in London, he was in business in London, and when he retired from business to devote himself to astronomy he built his observatory in London; and in spite of the fact

that the atmosphere of London is far from being an astronomer's ideal, all the observations which led to the discoveries on which his fame rests were made in London. This great Cathedral seems the appropriate resting-place of a memorial to one whose life and work were so linked up with this city.

Sir William Huggins was a prominent example of a type of man to whom English science owes much, the non-official worker. Like his contemporaries, Darwin and Joule, he never held any professorship or scientific appointment. When in 1858 he retired from business at an unusually early age, he seems to have been undecided as to whether he should devote himself to the microscope or the telescope. The telescope gained the day, and he built an observatory at Tulse Hill; he began by making drawings of the planets, but seemed to be losing interest and to be rather despondent, when Kirchhoff's determination of the chemical elements in the sun by the aid of spectrum analysis came to his knowledge. This was to him, he said, like water in a thirsty land, and he determined to attempt to find out the constitution of the stars by the same method. At the beginning of 1862 he persuaded Prof. Miller to join with him in the work, and in spite of the formidable difficulties due to the feebleness of the light, the mechanical difficulties of keeping the image of the star on the slit of the spectroscope, and the caprice of the London atmosphere, they were able to present to the Royal Society in 1863 a preliminary statement as to the spectra of some of the brighter stars, while in 1864 they published in the Philosophical Transactions of the Royal Society a general account of the spectra of about fifty stars, with a detailed study of some of the more important ones. They showed that the stars are made up of elements which, with few exceptions, are found in the earth. In 1864 Huggins made a discovery of capital importance in connection with the evolution of the stars, for he discovered a nebula the spectrum of which showed that it consisted of glowing gas, and was therefore in quite a different state of development from the stars he had examined, the spectra of which showed that their physical condition was analogous to that of the sun. Huggins threw himself with characteristic energy into the study of the spectra of the nebulæ, and found that the nebulæ were not all of one kind; some were stellar aggregates, while others were continuous masses of incandescent gases.

The importance of these results and the interest they excited were recognised by scientific societies with a promptitude almost without parallel. Three years after beginning serious scientific work he was elected a fellow of the Royal Society, the next year he was awarded a Royal medal, and after ten years he seems to have been elected to almost every scientific society in Europe. The work which commenced with such brilliance was carried on with undiminished ardour for nearly fifty years; since 1875 with the active co-operation of his wife. It showed throughout the characteristics so noticeable in the earlier work: the power to select the right problem to attack, the ability to devise the best way to attack it, and the industry to take boundless pains in overcoming the difficulties which sprang up at every turn.

On behalf of the Royal Society, I record with gratitude the help he gave to the work of that society, and especially to the distinction and dignity with which he for five years discharged the office of president. For the medallion we are indebted especially to Mr. Pegram, the artist whose skill has produced it, and to Miss Montefiore, who has borne the burden of the heavy work necessary to bring such a scheme to completion.

THE DEVELOPMENT OF VEGETATION.[1]

CONSIDERABLE scepticism is not infrequently expressed by botanists who are not ecologists as to the possibility of formulating a satisfactory natural classification of vegetation, *i.e.* of plant communities; and this scepticism is natural enough when we consider the numerous attempts, largely inconsistent and contradictory, that have been made in this direction, especially in recent years. It is obvious that the ultimate test of validity will be general acceptance, and certainly we cannot claim that there is anything like agreement among ecologists as to a natural scheme or as to the principles upon which such a scheme should be based. At the same time, it must be remembered that it took a very long time and constant efforts from many quarters to arrive at a natural system of classification of species which commanded anything like general acceptance. The task of the classifier of plant communities is much more difficult for many reasons the chief of which is that the outlines of the classificatory units—the plant communities—are frequently vague and shifting, owing to the multiplicity of causes and combinations of causes which determine their nature and limits. Some would doubtless go so far as to say that the units themselves are illusory, but it is significant that this is not the view of those who have seriously studied vegetation in the field.

The natural system of species has been ultimately established on a phylogenetic—*i.e.* a developmental—basis, and any other was impossible once the principle of evolution had been accepted. Prof. Clements's fundamental contention in the volume under review is that the natural system of plant communities must also be established on a developmental basis, and he includes in his purview not only present vegetation, but all the past vegetations that have come into existence since plant-life first appeared on the earth. As the basis of this contention Prof. Clements claims that the *plant formation*—his basic unit—is an organism.

Whether that claim can be admitted or not depends, of course, upon our conception of an organism. Starting with individual animals and plants, which are the typical, or, as some might say, the only, organisms, it is clear that we can, if we so choose, extend the conception to human societies, for instance, which certainly have very many of the same characteristics, though they have not the close-knit spatial unity of structure and function of the individual plant or animal. If we extend the conception further to include plant formations in Clements's sense, we drop from our concept one of the characteristics of the higher animal organisms and of human communities—the conscious co-operation of parts in pursuit of the ends of the whole. But neither is this a character found in the lower animals or in plants. Unless, therefore, we definitely restrict our conception of organism to individual animals and plants, we must concede Clements's contention that plant formations are organisms, and if we do so restrict it we have perforce to admit that the plant formation has many of the characters of organisms, a fact which we may perhaps express by calling the vegetation unit a *quasi-organism*.

Prof. Clements's plant formation is the plant community in equilibrium with its climatic habitat, *i.e.* determined and kept constant by the control of a distinct climate. The type of such a formation is the forest of definite floristic composition which maintains itself indefinitely so long as the climate maintains its general character. Prof. Clements points out that such a community has a definite organisation, *i.e.* a fixed spatial and functional relation between the plants

[1] "Plant Succession: an Analysis of the Development of Vegetation." By Prof. F. E. Clements. Pp. xiii+512+61 photographic plates and 51 figures in the text. (Carnegie Institution of Washington, 1916.)

composing it and with the substratum: it regenerates destroyed parts, and can reproduce itself in new situations; and, finally, it has a definite development or ontogeny.

It is this last feature with which the present volume is concerned. On bare ground or in water, within the climatic limits which determine the particular forest formation, there develops a succession of plant communities which ultimately gives rise to the forest. The causes of succession are the reactions of the successive plant populations on the habitat, which render it favourable to particular new invaders and less favourable to the existing occupants. The final stage, or climax, is reached when equilibrium is established and invasion no longer possible. The earlier course of development differs according to the nature of the substratum on which succession occurs, but the later phases correspond whatever the origin of the succession. This has been amply established in the case of several of the great forest climax formations of North America. As a particular instance W. S. Cooper has worked out in strikingly complete detail the successions culminating in the climax forest of *Abies balsamea, Betula alba*, var. *papyrifera*, and *Picea canadensis* on Isle Royale, Lake Superior. The primary successions in this case start from the bare rock shore or beach (xerarch successions), or from bogs and delta swamps (hydrarch successions), and through distinct series of definite and constant plant communities converge to the climax forest. Secondary successions are initiated by forest burns. If the humus is burned the resulting secondary succession is like the beach succession. When the humus is not burned the regeneration of the climax forest is much shorter.

In regions the climate of which does not permit of the establishment of forest the climax formations are of other vegetation types, such as desert or grassland; and here the successions from bare soil or water to the climax are shorter because woody plants are not involved.

Prof. Clements recognises the existence within the formation of *associations* which are "climax communities associated regionally to constitute the formation," and "are recognised chiefly by floristic differences." He thus maintains the practice almost universally agreed upon among ecologists of making the association a subordinate unit to the formation. Successively subordinate units of the association are designated as consociation (dominance of a single species), society, and clan. Parallel units are distinguished in the development series—*i.e.* those leading up to the formation in succession.

The author's foible is undoubtedly the multiplication of terms, a great number of which are proposed in this memoir. This is the concomitant of the compelling necessity he feels to establish complete systems of concepts logically worked out in every detail. Without entering upon a criticism of the validity of the conceptual systems themselves, which would occupy far more space than is at our disposal, it may be pointed out that the normal human mind invariably refuses to accept new concepts and terms until the progress of our knowledge of the relations of phenomena compels their adoption. It can scarcely be said that all Prof. Clements's terms are essential to clearness of thought and description. Some of them will no doubt come into general use, as some of the terms proposed in the author's "Research Methods in Ecology" (1905) have done.

The present work shows a great advance in maturity as the result of a wider experience, and is notable as the first systematic account of a fundamental phenomenon in vegetation. Its outstanding merit is logical thoroughness and completeness. It is impossible even to indicate the ground covered within the space of a short article.

The numerous photographs deserve quite special praise. They are not only of uniformly high standard and excellently reproduced, but they are admirably chosen to illustrate the text. A. G. T.

THE ZOOLOGY OF THE "TERRA NOVA" EXPEDITION.

FOUR further reports on the zoological material collected during the British Antarctic (*Terra Nova*) Expedition, 1910, have recently been issued by the British Museum (Natural History). Miss Massy (*Zool.*, vol. ii., No. 7, pp. 141–176, 43 figs.) describes sixty-eight specimens of Cephalopoda, which belong to seventeen species and twelve genera. Forty of the specimens belong to the Octopoda, the abundance of the genus Moschites being noteworthy.

The Decapod Crustacea, described by Mr. Borradaile (vol. iii., No. 2, pp. 75–110, 16 figs.), comprise forty-six species, but only three of these—all taken in the Ross Sea—are antarctic. In his account of *Crangon antarcticus*, Mr. Borradaile points out that the affinities of this antarctic shrimp lend some support to the hypothesis of bipolarity. One of the most interesting of the Decapods, a species of Porcellanopagurus taken off the northern end of New Zealand, forms the subject of a separate report (No. 3, pp. 111–126, 13 figs.). Mr. Borradaile points out that Porcellanopagurus is one of the many attempts of Nature to evolve a crab. This crab seems to have been evolved from an ordinary hermit-crab, and the method followed was not only, as in other such cases, a broadening and depressing of the cephalothorax together with a reduction of the abdomen, but also a drawing out horizontally of the edges of the hard plate which roofs the fore part of the body of a hermit-crab. Mr. Borradaile traces the relations between the various external features of Porcellanopagurus and those of a hermit-crab. He surveys other routes by which evolution in the direction of "carcinisation" has proceeded throughout the Anomura, and reaches the conclusion that there is in the constitution of the Anomura a disposition or tendency to achieve that special formation of body which constitutes a crab. Whether the tendency be primarily one of morphology or of habits is another question, but, seeing that a similar form of body has been reached independently in circumstances which must have needed very different changes in the habits of the animals, it would appear that a morphogenetic tendency is the primary factor, but that it can only be realised in the event of the development of suitable habits. Mr. Borradaile remarks that there are few better instances than those afforded by "carcinisation" of the fact that the organism is, after all, the dominant factor in evolution.

In No. 4 (pp. 127–136, 7 figs.) Mr. Borradaile gives an account of the fourteen species of barnacles brought back by the expedition. The most interesting specimens described are some valves, referred to a new species of Hexelasma, collected in a glacier, 30 ft. above sea-level, in Evans Cove, Terra Nova Bay. It is not possible to state from their appearance whether these valves are recent or fossil, but it seems scarcely probable that they are recent, for no trace of such a barnacle has been found in any collection from either the Ross Sea or elsewhere, nor can any satisfactory suggestion be made as to the way in which recent shells could have reached the position in which these were found. If they be fossil, it seems highly probable that they are, if not of Miocene age (their nearest known relation is *H. aucklandicum*

from the Miocene of New Zealand), at least Tertiary, for they are quite unlike any Cretaceous barnacle. But there is the difficulty that no Tertiary rocks are known from the neighbourhood of the glacier, nothing later than Carboniferous having been reported in this region, though it may be that the glacier is in contact somewhere in its course with Tertiary rocks.

EDUCATIONAL REFORM.

MR. T. H. J. UNDERDOWN, in his presidential address to the National Union of Teachers on April 11, revealed some deplorable facts as to the pay of teachers. It appears that more than forty-two thousand certificated teachers are paid less than 100*l*. per annum, and that the pay in many other cases is little short of scandalous. It is not surprising in the face of these facts to know that the supply of teachers has been failing seriously in recent years, and that the provision of a sufficient number of qualified men and women to carry out the educational developments contemplated in the programmes recently put forward is one of the most important practical problems to be solved. The precedent to reform, as Mr. Underdown pointed out, must be a fundamental change in the attitude of the nation as a whole towards its schools, colleges, and universities, and towards those who labour in them, both teachers and taught.

The recent Departmental Committee, as well as bodies like the Association of Directors and Secretaries for Education, the Association of Technical Institutions, the Workers' Educational Association, the British Science Guild, the Education Reform Council, and, lastly, the National Union of Teachers, whose programme of educational progress is now before us, are all practically at one in the demand for a reorganisation, to come into force as soon as possible, of the means and methods of national education, especially in their application to the domain of elementary instruction, and for the proper equipment of the schools in respect of practical training, the provision of playgrounds, and other means of physical education, together with proper measures for medical treatment for all children requiring it. There is, moreover, a strong agreement amongst all these bodies that measures shall be taken for the due and effective training of all the teachers engaged in the schools and the payment to them of adequate salaries. There is some hope that this consensus of opinion may induce Parliament to take into serious consideration, despite the exigencies and demands of the war upon the energies of the nation, the measures of educational reform proposed with a view to their early adoption. We cannot too soon, having regard to the dreadful wastage of our young, virile life, set about instituting provisions whereby we may effectively train the youth of the present generation for the responsibilities which surely await them. To neglect such measures will be fatal to the nation's best interests.

All the bodies above named are agreed that all exemptions interfering with full-time attendance up to fourteen years of age, including half-time, shall be abolished; that due provision shall be made whereby all young persons entering into employment between fourteen and eighteen years of age shall continue their education on general and specialised lines, in their working hours, which shall not exceed forty-eight per week, during about forty weeks of the year; and that it shall be the duty of the employer to give facilities, according to the circumstances of the locality, for the due observance of these conditions. The foregoing authorities further agree that the fullest facilities shall be given for all duly qualified young persons to proceed to institutions for higher education on such conditions as shall ensure their adequate maintenance in such institutions. Suggestions are also made for the simplification of the payment of public grants in aid of education, so as to ensure that local authorities shall give adequate encouragement to all forms of education essential to the well-being of their respective areas.

The subjoined extracts from Mr. Underdown's address show that there can be little hope of any of these educational reforms being carried out until the pay and prospects of teachers are improved.

The most urgent and pressing reforms awaiting enactment by Parliament are: (*a*) The abolition of half-time, and other forms of wage-earning, child labour. (*b*) The prohibition of street trading by persons under the age of sixteen or eighteen. (*c*) The raising of the statutory minimum leaving age from twelve to fourteen, accompanied by powers under local by-laws to enforce attendance to fifteen or sixteen. It is little use to attempt to extend the superstructure of higher education provided by secondary, technical, and continuation schools, urgent though these extensions be, until the foundations in the primary schools are truly and firmly laid.

The reforms I have indicated are of supreme importance, yet every attempt to set them afoot is foredoomed to failure unless accompanied by immediate steps to secure an adequate supply of qualified teachers. Every single project carries with it an added demand for further teachers. For example, the raising of the leaving age to fourteen would retain an additional 250,000 children for at least a year, which on a basis of forty children per teacher—not by any means a liberal standard of staffing—would require an additional 6000 fully qualified teachers. But the supply is failing, apart from the fact that of the 20,000 teachers on war service many will either remain in the Army or Navy, or find other posts with brighter prospects. The number of intending teachers in 1906 was 11,901, and this fell to 5679 in 1912, and although a slight increase to 6938 is shown in 1916, the improvement is quite inadequate to warrant any confidence for the future. From these numbers must be deducted a large percentage who fail to qualify. Figures given by the Board of Education in 1915 show that in a recent year only 63 per cent. of the bursars and 53 per cent. of the pupil teachers afterwards proceeded to a training college to complete their qualifications. Thus only a few more than half the 6030 entrants, the average number for the last six years, are likely to become fully qualified teachers. This supply of 3000 per annum is totally inadequate, as the wastage amongst teachers has been estimated at 7000 yearly, due to loss by death, superannuation, breakdown in health, transfer to other more lucrative walks of life, and to marriage, which was found over a period of twenty years to account for 75 per cent. of the removals of women teachers from the profession.

Here are the facts relating to the salaries of full-time certificated teachers as shown by the latest information published by the Board of Education in 1915. In England and Wales, out of nearly 106,000 certificated teachers, two headmasters, one headmistress, one certificated assistant-master, and 218 certificated assistant-mistresses received less than 50*l*. per annum—that is, less than 19*s*. 3*d*. per week. The facts are:

Certificated masters		Certificated mistresses		Less than £		Less than s.
3	...	219	...	50	=	19¼ per week
42	...	1,135	...	60	=	23 ,, ,,
315	...	4,568	...	70	=	27 ,, ,,
758	...	13,020	...	80	=	30 ,, ,,

Viewed in another way:—

468	headmasters	Received less than 100*l*. a year = less than 38*s*. 6*d*. per week.
4,783	certificated assistant-masters	
4,847	headmistresses	
32,013	certificated assistant-mistresses	

Total 42,111 certificated teachers

From these meagre sums, 3*l*. 12*s*. for men and 2*l*. 8*s*. for women are deducted every year towards an equally meagre superannuation allowance. These thousands of professional, educated men and women, selected by the State, medically examined at more than one stage of their academic preparation and professional training, tested by his Majesty's inspectors of schools as to fitness over and over again—these men and women are disgracefully and shamefully paid. These are strong words, but not too strong in face of the facts, whether viewed in their individual incidence or in bulk—*i.e.* 42,111 out of 105,930 fully certificated teachers employed in 1915, or about 40 per cent., received less than 38*s*. per week. Further, these figures take no account of the salaries of 41,000 uncertificated teachers and 13,000 supplementary teachers, in which classes the salaries are probably not more than 50 per cent. of those for the certificated teachers above mentioned.

It may be argued by some that these low salaries are limited to the inexperienced members of the profession. It is not so, as will be shown. The 42,000 certificated teachers receiving less than 100*l*. per annum are, as a body, not inexperienced, for they represent at least a ten-years' supply. This line which I have drawn at 100*l*. a year should be, in my opinion, the minimum salary permitted by the Board of Education. It should be the basis of the teachers' contract clause. Below that standard, no man or woman, having passed through the full training course, and commencing a professional career at twenty or twenty-one years of age, should be engaged. Any product not worth 100*l*. a year ought not to be entrusted with the vital work of teaching children. With 250*l*. as a minimum wage for a medical practitioner upon the body, surely even 150*l*. is not an ambitious or unreasonable starting salary for a newly trained teacher, a fully qualified practitioner upon the child's mental, moral, and physical development. That ripe experience and long service do not always carry a fuller reward is shown by the following cases collected a few months ago by the National Union of Teachers:—

(*a*) *Headmaster* in eastern county, appointed thirty years ago at 87*l*. per annum, present salary 96*l*. During these thirty years he must have satisfied the Board of Education, or he would not have held his post. His reward for thirty years' service is an increase of 9*l*. per annum.

(*b*) *Headmaster* in eastern county, appointed more than forty years ago at 70*l*., now receives 95*l*., with no increase during the past seven years.

(*c*) *Headmistress*, county near metropolis, commenced service in present post thirty years ago at 48*l*., and now receives 70*l*.

(*d*) *Headmistress*, neighbouring county, appointed at 23*s*. per week thirty-five years ago, has never received a farthing increase during the whole time.

(*e*) *Headmistress*, a Welsh county, salary was 90*l*. for twenty-six years without revision.

(*f*) *Headmistress*, a Welsh county, has held post for thirty-three years, and advanced in salary from 90*l*. to 97*l*. 10*s*.

(*g*) *Headmistress* in East Anglia receives 70*l*. after eighteen years of service.

(*h*) *Headmistress* in the broad-acred county receives salary of 80*l*. after service of seventeen years.

These are but typical cases. They throw a searching light upon the conditions of rural teachers. Small wonder is it that some county authorities advertise scores of vacancies for teachers, posts they can never hope to fill again at the wretched salaries offered.

Another aspect of the problem is the opening up to young educated people of other avenues and walks of life which are more attractive in prospects, less costly in training, less exacting in the daily task, and more substantially remunerative. The bank successfully competes with the classroom for the services of the educated woman. The counting-house, the insurance office, the engineering works, to say nothing of the other professions, provide far brighter prospects for the youth than he can hope to realise as a teacher. Thus the teaching profession stands to lose its fair proportion of the supply of the best brains the nation produces. The only sources of supply likely to remain permanently are the few vocationally called to the labour, and those who find themselves eliminated from other more coveted positions by the sieve of competition.

Those already in the service find themselves cramped, barred, and chained by small prospect of promotion to higher posts, both professional and administrative, and by the narrow limits of the scale of salaries. The class-master of to-day has in most large towns only a 1 in 100 chance of promotion to a headmastership, and this for the fortunate few rarely takes place before they are forty-five years of age. His position is therefore practically permanent, and his salary stationary until the end—his retirement at sixty-five years of age. If the fully qualified class teacher is to survive as a professionally living force in the schools, the outlook must be made brighter and the position such as will provide for an educated man or woman a satisfactory career in itself and within its own confines. The present salaries fall far short of such prospects.

Inadequate retiring allowances further accentuate the check upon the supply of teachers. The maximum pension for a master retiring now at sixty-five years of age, after forty-five years of service, is 69*l*., and for a mistress 60*l*. Further, the Teachers' Superannuation Act of 1898 applies only to service in State-aided primary schools. Service in a secondary, technical, or other school does not count. This places an obstacle in the way of that free intercourse from one type of school to another which is so essential for the life and vigour of our educational system from the kindergarten to the university. A pension scheme embracing all sections of the profession is long overdue. The retiring age of sixty-five is far too high, and retirement should be optional at sixty. The fact that the premiums paid (3*l*. 12*s*. per annum for men and 2*l*. 8*s*. for women for possibly forty-five years) are non-returnable in the case of death before pension age is unsatisfactory. This basis may have been justified in the early years of the scheme, when fewer premiums were paid in by those reaching pension age, but as time goes on this system becomes more and more speculative, and indeed approaches the nature of a gamble. Scotland has granted to the whole of the teaching profession a pension scheme without these defects, and what Scotland did yesterday England can do to-day. If the same careful forethought, the same skilful plans and designs, and the same generous consideration which are used to cajole young persons into the profession were applied to schemes for the improvement of the teacher's prospects in his riper years and old age, a permanent and ample supply of excellent material for the teaching staff of the nation's schools would follow as the dawn follows the night.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The Duke of Richmond and Gordon has been elected Chancellor of Aberdeen University in succession to the late Lord Elgin.

It is announced that Mr. Henry Musgrave proposes to contribute a sum of 10,000*l*. to Queen's University, Belfast, to endow a chair in connection with Russian language and literature.

New buildings for the arts faculty, the library, and the general museum of the University College of North Wales were put up on a particularly fine site in the city of Bangor a few years ago, and were opened by his Majesty the King on July 14, 1911. The funds, a large proportion of which had been contributed by the rural districts of North Wales, did not suffice for the re-housing of the science departments. These, including agriculture and forestry, which are of the first importance in the neighbourhood, have remained in buildings of a purely temporary character, which were adapted for the purpose some thirty years ago. A movement has now been initiated by Mr. R. J. Thomas, of Holyhead, to erect buildings for the science departments on the new site, as a "memorial to the men of North Wales who have fallen in the war." Mr. Thomas has started the fund with a gift of 20,000*l*., and it is hoped to raise at least 150,000*l*. In the new buildings especial prominence will be given to agriculture and forestry, which are, or will be, the main industries of the northern counties of Wales. Other branches of science —physics, chemistry, geology, botany, zoology, and so forth—are provided for in the scheme. It is the intention of the authorities to erect laboratories on what may be termed a modern university scale. The high ability for science, as well as for literature, which so often appears in the remote rural districts of North Wales will in the new laboratories find fuller opportunity than heretofore. It is a pleasure to record that his Majesty the King (the Chancellor of the University), H.R.H. the Prince of Wales, and the Prime Minister have each expressed their approval of, and their sympathy with, the scheme.

With the growing advances in technical education it is very desirable that teaching connected with the building trade—one of the largest trades in this country—should be properly organised. The "Memorandum on the Teaching of Building in Evening Technical Schools," recently issued by the Board of Education (Circular 978), is intended to convey suggestions as to organisation, accommodation, equipment, and methods of instruction to teachers and those responsible for arranging building classes. At the same time, we are glad to see it stated that these suggestions are not designed to stereotype methods of procedure, which must vary with the needs of different localities. Most technical institutions possess some classes suitable for students interested in building, but in many cases these are inadequately correlated with other courses which it is desirable a student should take in addition, and the memorandum urges the desirability of "grouped" courses which shall give the worker a sustained interest and provide him with an adequate time-table. Further, it is pointed out that such courses should be arranged to form a continuous scheme from quite junior to advanced work, and that for those whose field of operations or whose intelligence is too limited to render a full course suitable a parallel restricted scheme of work should be arranged. It is impossible here to enter into the detailed suggestions given in the fifty pages of this publication, which cover not only the ordinary building trades proper, but also surveying and office work; it may be noted, however, that a laudable effort has been made to show in what manner mathematics and pure science can be brought to bear upon the direct needs of the builder. In conclusion, some comments on the material requirements of these subjects, in the way of lecture-rooms and laboratories, are given, which include plans of a combined lecture- and drawing-room found to be satisfactory, and of a building laboratory showing the arrangement of the various fittings.

SOCIETIES AND ACADEMIES.

London.

Aristotelian Society, March 5.—Dr. H. Wildon Carr, president, in the chair.—Prof. C. **Lloyd Morgan**: Fact and truth. We may start with facts of appearance, as a convenient point of departure. A fact of appearance is always relational in structure, and it is this relational structure which is of the very essence of fact. All facts of appearance are facts *for* knowledge, but we need to distinguish facts *for* knowledge and facts *of* knowledge. We may winnow out from the multiplicity of facts *for* knowledge certain facts *of* knowledge which have a privileged status, and we may speak of a fact of knowledge as accordant with a privileged fact of appearance without denying that accordance may merge in identity. We may then further distinguish between "the sphere of knowledge" and "the sphere of the knowable"—a fact of knowledge as an item of content on the sphere of knowledge may be said to be correspondent to a knowable fact, when the radii of the two spheres in contact are in the same right line. And here again correspondence may merge in identity—the difference between knowable fact and fact of knowledge being a difference in context. The relation between any knowable fact on a non-contact radius of the sphere of the knowable, and any imagined fact on a non-contact radius of the sphere of knowledge, is given in practical determination by the nature and amount of rolling of the spheres requisite to establish right-line contact. Right-line contact is that of direct acquaintance when the knowable and that which is then and there factually known are one. Fact is always particular, always a "this" or "that" dateable and placeable. But owing to the enormous amount of repetition in the total fact-structure of the knowable world, truths as well as facts of knowledge enter into the structure of the sphere of knowledge. There is (*a*) truth in the structure of the knowable world, (*b*) truth in the structure of knowledge, and (*c*) truth as correspondence of these two structures.

Royal Anthropological Institute, March 27.—Sir Hercules Read, president, in the chair.—Miss M. Edith **Durham**: South Slav customs as seen in Serbian ballads and tales by Serb authors. Until quite recent times justice, in South Slav lands, was administered by the headmen of the district, who sat before the church and considered the evidence and judged accordingly. The number of headmen summoned depended upon the gravity of the case. In the case of a blood-feud twenty-four was the usual number. They made an account, balancing one dead man against one dead on the other side, and reckoning the value of the wounds at so many "bloods" apiece—each blood to be paid for. Peace was made by members of the opposing families or clans swearing blood-brotherhood, and by a member of the injured family standing godfather to an infant of the other family. Godfatherhood was reckoned as blood-relationship, and the two families were thus united. Vuk Vrchevitch, who collected and

noted local customs between 1835 and 1889, has recorded many curious verdicts given by the "Council of Good Men," as it was called. Much information about local customs is obtained from the ballads of the land. In the poems of Voyvoda Mirko, the father of the present King of Montenegro, we get much detail about the practice of head-hunting. The Montenegrins were great head-hunters. He describes the setting of heads on stakes around a village as lately as 1857; also the plundering and stripping of the dead and the sharing of the booty. It was all pooled and distributed by the chieftain.

Geological Society, March 28.—Dr. Alfred Harker, president, in the chair.—F. **Dixey** and Dr. T. F. **Sibly**: The Carboniferous Limestone Series on the south-eastern margin of the South Wales coalfield. The outcrop dealt with extends from the valley of the Ewenny river near Bridgend (Glamorgan) to that of the Ebbw river at Risca (Monmouth), a distance of about nineteen miles from west-south-west to east-north-east. It is traversed by the rivers Ely, Taff, and Rhymney. Traced north-eastwards along this outcrop, the Carboniferous Limestone Series suffers much attenuation and becomes mainly dolomitic, as shown by the officers of H.M. Geological Survey during the recent re-survey of the coalfield. The outcrop now described supplies a key to the remarkably attenuated development of the Carboniferous Limestone Series which is known to prevail on the eastern and north-eastern borders of the coalfield. Overstep and actual thinning are both operating in a north-easterly direction to produce great attenuation. A detailed description of the lithological and faunal succession is given. The physical features of the outcrop are described, and attention is directed to the remarkably perfect adjustment of minor drainage-lines to geological structure. The paper is illustrated by maps on which the zonal divisions are indicated, by horizontal and vertical sections, and by photographs which depict some of the most interesting features of the scenery.

Royal Astronomical Society, April 13.—Major P. A. MacMahon, president, in the chair.—Rev. J. G. **Hagen**: Missing B.D. stars. Some stars, recorded in the Bonn Catalogue, are now not found in the sky. In a few cases it appeared that, through bad focus, faint stars close together had been observed as one star, and in six cases the R.A. of one star had been accidentally combined with the declination of another. —Prof. S. D. **Tscherny**: Observations made during the partial eclipse of the sun of January 22, made at Rostow-on-Don, Russia.—Dr. L. **Silberstein**: The motion of the perihelion of Mercury, deduced from the classical theory of relativity. It was well known that the motion of the perihelion of Mercury was greater than could be caused by the perturbations of the other planets, the excess being now found to be nearly 43″ per century. Einstein's most recent "generalised theory of relativity" had yielded for this excess its full value. It therefore appeared worth while to investigate if the excess would not also be accounted for by the old theory of relativity, retaining the constancy of the velocity of light, and its independence of the gravitational field.—Prof. H. H. **Turner**: Note on possible attraction between photographic images. Cases occurred in which the image of a bright star appeared to distort a réseau line near it, and he had found a similar effect produced when réseau lines, twice copied on the same plate, crossed each other at small angles. Mr. Bellamy had examined the measures of double stars in the Oxford Astrographic Catalogue, and found the same order of error for distances less than 7″, though nothing sensible beyond this.—Prof. A. **Fowler** and J. **Brooksbank**: The third line spectrum of oxygen. Spectra had been obtained with feeble, moderate, and strong discharges, and slides from the photographs were shown. The stellar lines, which can be identified with the third line spectrum of oxygen, are not numerous, but it is of interest to find in oxygen another example of the occurrence in the earliest type of stars of lines which we can only obtain by employing the strongest discharges. This may indicate that in stars of early type we are presented with phenomena resulting either from powerful electric action or from extremely high temperatures.

Paris.

Academy of Sciences, March 26.—M. A. d'Arsonval in the chair.—P. **Appell**: Short report of the Committee on Ballistics.—E. **Bompiani**: Deformable hypersurfaces in a real Euclidean space of $n>3$ dimensions. —E. **Kogbetliantz**: The summation of ultraspherical series.—E. **Belot**: The possible origin of star clusters. The vortex theory in cosmogony, which has already explained the laws of the solar system and the formation of spiral nebulæ, can also define the very special conditions under which a star cluster can arise, and gives an exterior distribution very nearly exponential. —M. **Fayet**: Observation of Mellish's comet made at the Observatory of Nice.—J. **Pellissier**: Some geometrical properties of a bundle of X-ray tubes. Applications to the localisation of foreign bodies in the organism. An application of the principles of anharmonic ratios and of homography to X-ray problems. —J. **Fromentin**: A rapid radioscopic method for the localisation of projectiles.—Em. **Bourquelot** and A. **Aubry**: The biochemical synthesis, with the aid of emulsin, of a second galactobiose. On working up the residues from the preparation of the galactobiose described in an earlier paper, with the view of obtaining an increased yield, a new sugar, isomeric with the first, has been obtained. Its physical and chemical properties are given.—P. **Bonnier**: Incontinence of urine. An account of the application to sixty-two cases of the method of cauterisation of the branches of the trigeminal nerve in the nose previously described. Thirty-eight cases were cured and nine improved.—A. **Paillot**: New parasitic micro-organisms of the caterpillars of *Lymantria dispar*.—J. **Danysz**: The treatment of some dermatoses by bacteriotherapy.—Ed. **Delorme**: The operative methods applicable to wounds of nerves by projectiles.

Washington, D.C.

National Academy of Sciences (vol. iii., No. 1, January). —E. **Thomson**: Inferences concerning auroras. Auroras consist of vertical streamers which, seen from different points of perspective, give the various optical effects observed.—H. F. **Osborn**: Application of the laws of action, reaction, and interaction in life evolution. In each organism the phenomena of life represent the action, reaction, and interaction of four complexes of physico-chemical energy.—P. W. **Bridgman**: The resistance of metals under pressure. Twenty-two metals are examined up to 12,000 kg.—A. **Forbes**: The rate of discharge of central neurones. The normal frequency of nerve impulses discharged from the ganglion cells in voluntary contraction must lie between 300 and 5000 per second.—Ethel B. **Harvey**: A physiological study of Noctiluca, with special reference to light production, anæsthesia, and specific gravity. These animals are able to regulate their specific gravity. Anæsthetics seem to attack the mechanism of the utilisation of oxygen, in the absence of which light is not produced. —N. M. **Fenneman**: Physiographic subdivision of the United States. The basis of division shown on the map is physiographic or morphologic. There are twenty-four major divisions, some with six to ten sub-

divisions.—S. **Hatai**: The composition of the Medusa, *Cassiopea xamachana*, and the changes in it after starvation.—H. **Shapley**: Studies of the magnitudes in star clusters, iv. On the colour of stars in the galactic clouds surrounding Messier 11. The frequency-curve for colours shows great diversity of colour index and general resemblance to the curve for the brighter stars in the neighbourhood of the sun. A striking progression of colour with decreasing brightness is shown. —F. H. **Seares**: The colour of the standard polar stars determined by the method of exposure-ratios. The colours of the polar standards, brighter than the 13th magnitude, have been determined to about the same precision as was reached in the investigation of the magnitude scale, with an expenditure of time and labour perhaps a tenth of that in an earlier investigation.—C. **Keyes**: Terracing of bajada belts. The feature of desert bajada-terracing, when explained upon a strictly aqueous basis, cannot but lead to complete misinterpretation. It is far more largely the result of wind-action.—C. D. **Perrine**: Relation of the apex of solar motion to proper motion, and on the cause of the differences of its position from radial velocities and proper motions.—Brig.-Gen. H. L. **Abbot**: Hydrology of the Isthmus of Panama. Extensive tables for rainfall, outflow, evaporation, etc., are given and discussed.—C. P. **Olivier**: The meteor system of Pons-Winnecke's comet. The elements of the meteor's orbit are determined from more than 1000 observations.—T. W. **Richards** and H. S. **Davis**: Improvements in calorimetric combustion, and the heat of combustion. The improvements are: means of effectively closing the bomb with less risk to the lining and cover; means of burning volatile liquids without loss; a method of automatically controlling the temperature of the environment; means of evaluating the incompleteness of combustion. The heat of combustion of toluene is determined as 10·155 calories (18°) per gram.—R. C. **Tolman** and T. Dale **Stewart**: The mass of the electric carrier in copper, silver, and aluminium. A continuation of experiments on currents produced by acceleration in metals.—E. B. **Rosa** and G. W. **Vinal**: The silver voltameter as an international standard for the measurement of electric current. A summary of eight years' experimental work which has shown how the voltameter can be used as a trustworthy current standard and as a means of checking the constancy of the value of the Weston normal cell.

BOOKS RECEIVED.

Guide to Materials for American History in Russian Archives. By Prof. F. A. Golder. Pp. 185. (Washington: Carnegie Institution.) 1 dollar.

Théorie de la Contre-Evolution ou Dégénérescence par l'Hérédité Pathologique. By Dr. R. Larger. Pp. xiv+405. (Paris: F. Alcan.) 7 francs.

Dairy Farming. By Prof. C. H. Eckles and Prof. G. F. Warren. Pp. xv+309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. net.

Air Power: Naval, Military, Commercial. By C. Grahame-White and H. Harper. Pp. 262+20 illustrations. (London: Chapman and Hall, Ltd.) 7s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, April 19.

Royal Institution, at 3.—Industrial Finance after the War; The Character of the Industrial Struggle of To-day: Prof. H. S. Foxwell.

Mathematical Society, at 5.30.—A Liquid Gyrostat: Prof. W. Burnside.—The Integral Formula for Generalised Legendre Functions: G. N. Watson.—A Substitution Permutable with the Transposed Substitution: Prof. H. Hilton.

Linnean Society, at 5.—The Heterangiums of the British Coal Measures: Dr. D. H. Scott.—Hypophysis and Premandibular Cavities; a Suggestion: E. S. Goodrich.—Wooden Scratching Tools made by an African Parrot: Miss N. Layard.

Institution of Mining and Metallurgy, at 5.30.—Annual General Meeting.—Stope Measurement at Messina: W. Whyte.—Platinum in Spain: F. Gillman.

Chemical Society, at 8.—The Hydration of Ions and Metal Overvoltage: E. Newbery.—The Pungent Principles of Ginger. Part i. A New Ketone, Zingeribone, occurring in Ginger: H. Nomura.—Velocity of Decomposition and the Dissociation Constant of Nitrous Acid: P. C. Rây, M. L. Dey, and J. C. Ghosh.—The Alkaloids of Ipecacuanha. Part ii: F. L. Pyman.—Studies in Catalysis. Part vi. The Mutual Influence of Two Reactions proceeding in the same Medium: R. O. Griffith, A. Lamble, and W. C. McC. Lewis.—Studies in Catalysis. Part vii. Heat of Reaction, Equilibrium Constant, and Allied Quantities from the Point of View of the Radiation Hypothesis: W. C. McC. Lewis. —Note on the Isolation of Methylnonylketone from Palm Kernel Oil: A. H. Salway.—Metallic Derivatives of Alkaloids: J. N. Rakshit.

Royal Society of Arts, at 4.30.—The Industrial and Economic Development of Indian Forest Products: R. S. Pearson.

FRIDAY, April 20.

Royal Institution, at 5.30.—The Future of Wheat-growing in England: Prof. R. H. Biffen.

Institution of Mechanical Engineers, at 6.—Presidential Address: M. Longridge.

SATURDAY, April 21.

Royal Institution, at 3.—Principles of Aerial Navigation: Prof. G. H. Bryan.

MONDAY, April 23.

Aristotelian Society, at 8.—Symposium: Ethical Principles of Social Reconstruction: Principal L. P. Jacks, G. Bernard Shaw, C. Delisle Burns, and Miss H. D. Oakeley.

TUESDAY, April 24.

Royal Institution, at 3.—Russian Development—The Rise of Moscow: Prof. C. R. Beazley.

WEDNESDAY, April 25.

Royal Society of Arts, at 4.30.—Flour and Bread: Sir Francis Fox.

THURSDAY, April 26.

Royal Institution, at 3.—Industrial Finance after the War: Prof. H. S. Foxwell.

Institution of Electrical Engineers, at 6.—High-tension Overhead Transmission Lines: G. V. Twiss.

FRIDAY, April 27.

Royal Institution, at 5.30.—The Organs of Hearing in relation to the War: Dr. Dundas Grant.

SATURDAY, April 28.

Royal Institution, at 3.—Principles of Aerial Navigation: Prof. G. H. Bryan.

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THURSDAY, APRIL 26, 1917.

MEMORIES OF SIR DAVID GILL.

David Gill, Man and Astronomer. Memories of Sir David Gill, K.C.B., H.M. Astronomer (1879–1907) at the Cape of Good Hope. Collected and arranged by George Forbes, F.R.S. Pp. xi+418. (London: John Murray, 1916.) Price 12s. net.

LE volume publié par Sir David Gill en 1913 décrit son œuvre essentielle, mais ne renseigne pas sur l'homme même. Aujourd'hui, une plume autorisée fait connaître sa vaste intelligence, son caractère, son désintéressement, ses qualités du cœur. Un de ses amis, M. G. Forbes, en a peint un portrait dont les astronomes lui seront toujours reconnaissants. C'est la lecture de la correspondance largement reproduite dans ce livre qui l'a mis en état de pénétrer cette personnalité si ouverte et si franche. Gill était très réservé, et peut-être seule une femme connaît le bien qu'il a fait, révélé par des lettres dont la publication est impossible.

La formation, l'œuvre, le charme d'un véritable astronome, telles sont les trois parties de l'ouvrage. Le livre est d'une lecture entraînante. Gill a fait tant de choses, et si bien, que le lecteur non averti pourrait se croire en face d'une œuvre d'imagination. Mais c'est bien Gill que nous fait connaître M. G. Forbes. Nul doute qu'en France l'Amiral Mouchez et ses successeurs auraient donné à ce livre leur plus complète approbation.

David Gill naquit à Aberdeen, le 12 juin 1843, dans une maison d'horlogerie très prospère. Il y succéda à son père en 1869. Sa famille était très estimée. Sa mère, très intelligente, d'esprit large, active, enthousiaste, était fière de lui. Il l'adorait.

Ecolier, David, joyeux camarade, n'était pas un enfant prodige. C'est à Dollar, à quatorze ans, que se révélèrent ses aptitudes scientifiques. De 1858 à 1860, il assista à Aberdeen aux leçons de James Clerk Maxwell qui le distingua. Puis il parcourut en Suisse, en France, en Angleterre les centres horlogers, devenant un très habile artiste et se familiarisant avec la langue française. De 1863 à 1872, il resta dans la maison de son père.

Son mariage avec Isobel Black fut l'événement capital de sa vie. Dès la rencontre, en 1865, il en fut éperdument épris. Il avait vingt-deux ans, elle seize. M. Forbes a pu recueillir les premières impressions d'*elle* sur *lui*. Nous ne pouvons ni abréger, ni tout citer. Voici la dernière ligne: "It is 'the sound of a voice that is still' which haunts my memory every hour." Mariés en 1869, les jeunes époux s'établirent à Aberdeen, où Isobel comprit que, passionné pour l'astronomie, David ne pourrait passer sa vie dans les affaires. Mais quel miracle lui permettrait de réaliser son rêve? "En 1872, le miracle s'accomplit et il passa dans sa terre de Chanaan." Elle ne savait pas l'astronomie; "pas un mot, Dieu merci," répondit un jour Gill, mais elle n'hésita pas à laisser tout pour sa gloire.

Gill, apte aux études les plus diverses, débuta en astronomie à King's College, en installant un instrument pour donner l'heure, et un équatorial. Entre temps, lieutenant au corps des volontaires, il s'exerçait au tir. Sans goût pour le commerce, il s'y appliquait par devoir. Ayant monté, en 1867, dans le jardin de son père, un excellent miroir en verre argenté, il observa des étoiles doubles et prit, en 1869, une très bonne photographie de la Lune. L'ayant vue chez Huggins, Lord Lindsay obtint, en 1871, que son père prît Gill pour directeur de l'important observatoire qu'il projetait de créer dans sa résidence à Dun Echt. Pour Gill, c'était la réalisation de son rêve. Avec un entier désintéressement, sa femme et lui acceptèrent. De haut intérêt sont le tableau de cette collaboration où les deux jeunes hommes publièrent tout en commun, le récit du voyage de Gill en Europe pour la commande des instruments, celui du voyage de Lord Lindsay et de Gill à Maurice pour déterminer la parallaxe du Soleil par le passage de Vénus et par Junon; au retour, le levé de la grande pyramide, l'offre d'engagement par le khédive. Mais, revenu à Dun Echt, Gill recevait des visites des plus grands astronomes. Pour Lady Crawford, mère de Lord Lindsay, les conditions du contrat étaient changées; Lord Lindsay et Gill durent se séparer, mais restèrent étroitement amis.

Suivit le voyage à l'Ascension, en 1877, dont un récit a été publié en 1880 par Lady Gill sous le titre "Six Months in Ascension." Après des peines infinies, Gill fit une série splendide d'observations de Mars; la question de la parallaxe du Soleil était résolue. Lauréat de l'Institut de France, médailliste de la Royal Astronomical Society. Gill était classé parmi les astronomes illustres. Il eut la médaille d'or en 1908 pour la seconde fois, pour ses contributions à l'astronomie de l'hémisphère sud.

En 1879, il succéda à Stone au Cap; il apprit sa nomination par Lord Lindsay dont l'appui surmonta cet obstacle: Gill n'était pas un mathématicien de Cambridge. On m'excusera d'ajouter qu'aux fêtes du 250e anniversaire de la Société royale, Sir G. H. Darwin me dit combien grand encore était cet obstacle pour un astronome.

Les chapitres x. à xx. contiennent un tableau saisissant de ce qu'a fait cet homme de grande intelligence, qui savait bien ce qu'il voulait. Dès son arrivée, sa déférence vis-à-vis des représentants de l'Amirauté lui permit de commencer des travaux géodésiques qui ont abouti à cette extraordinaire entreprise: l'arc de méridien du Cap au Caire. En attendant un héliomètre de sept pouces, il achetait de ses deniers celui de Lord Lindsay et, avec Elkin, mesurait des parallaxes stellaires. Il voulait un grand télescope; Newall offrait de lui prêter le sien; on refusa; en 1894, F. McClean offrit à l'Observatoire du Cap le magnifique télescope Victoria. Il n'eut qu'en 1897 un cercle méridien retournable, mais c'est, sans doute, l'instrument le plus précis

existant. Il avait employé l'héliomètre de sept pouces à déduire la parallaxe du Soleil de mesures d'Iris, Victoria, Sappho, par cette magnifique coopération de vingt-deux observatoires et d'astronomes tels que Newcomb et Auwers.

Les accidents comme ceux qui avaient failli détruire les instruments avant le départ pour Maurice et l'Ascension ne troublaient Gill que quelques minutes; il y remédiait d'urgence. De hasards heureux, tels que l'offre de Lord Lindsay, ou l'obtention d'une remarquable épreuve de la comète 1882 avec l'objectif d'un amateur, il profitait. Voyant sur cette épreuve nombre d'étoiles, il annonça que l'on allait pouvoir photographier les cartes stellaires. Ce fut l'origine de la C.P.D. pour laquelle il eut la joie de recevoir l'offre de collaboration de Kapteyn.

L'Amiral Mouchez avait appuyé à l'Académie des Sciences l'affirmation de Gill concernant les cartes stellaires. On sait par quels efforts et avec quel succès P. et Pr. Henry construisirent des objectifs qui, en 1884 et 1885, leur donnèrent des clichés admirables qui furent tirés en héliogravure. En apprenant d'Huggins "in enthusiastic terms" ces importants résultats, Gill, le 23 décembre 1884, puis le 18 janvier 1885, demanda des renseignements à l'Amiral Mouchez, qui lui envoya, le 22 janvier, une épreuve ordinaire et une épreuve héliogravée, l'informant qu'il avait commandé un grand appareil spécial et ajoutant: "Je crois que nous allons obtenir la solution complète des cartes célestes par la photographie." Le 23 février, Gill répond à l'Amiral une longue lettre non publiée où il insiste sur les "splendides efforts faits à Paris": dans cette lettre, il est question de la C.P.D., des cartes écliptiques de Paris, des amas, de la voie lactée, travail à entreprendre sur un plan soigneusement préparé, et aussi de photographies d'aires uniformément distribuées. Le 11 mai, l'Amiral disait à l'Académie: "M. Gill . . . m'a adressé immédiatement un projet pour établir une entente entre divers observatoires afin d'entreprendre ensemble le plus tôt possible la Carte du Ciel qu'il serait facile d'exécuter ainsi en six ou huit années." Nous n'avons pu retrouver la lettre même de Gill; mais ces indications suffisent pour établir la part qui revient à l'initiative de Gill et de l'Amiral Mouchez, à la science et à l'extraordinaire habileté de P. et Pr. Henry, dans cette magnifique entreprise. On sait le reste. En 1909, au sixième Congrès, les Français ont été heureux de proposer pour Gill le titre de président d'honneur, voté d'acclamation.

M. Forbes s'étend sur les difficultés que Gill eut ensuite à surmonter; mais, depuis vingt ans, avec la France et huit autres nations, Greenwich, Oxford, le Cap, les colonies anglaises collaborent. Gill, Mouchez, P. et Pr. Henry ne sont plus; le travail n'est pas terminé; le travail d'Eros, tant à l'honneur du Comité Permanent et dont le résultat donné par A. R. Hinks est si glorieux pour Gill, a pris trois ans; et la guerre déchaînée par l'Allemagne le retarde encore; mais l'influence des initiateurs n'est pas éteinte; ce qui n'est pas fait se fera. Le Président du Bureau du Comité international Permanent n'a, au sujet de l'achèvement rapide de l'entreprise, aucune crainte.

Gill était un organisateur; il s'intéressait aux arts, aux affaires générales. Au Cap, il présidait maintes réunions et son knighthood fut en partie la récompense des services qu'il y rendit à l'Empire. Sa maison était ouverte aux artistes, aux marins, aux visiteurs distingués. Causeur plein d'entrain, il avait établi au Cap, avec la discipline d'Airy, la cordialité de Poulkowo. Son influence s'y fera longtemps sentir; il fut heureux du choix de son successeur. Rentré à Londres, il eut un rôle important dans les sociétés savantes et, sur le continent, dans les entreprises internationales. Il semblait toujours heureux de revenir à Paris, et non moins de faire les honneurs de son *flat*, à Londres.

Il aimait le peuple, sympathisait avec ceux qui souffrent. Il n'eut pas d'enfants, mais à la mort de sa sœur, Mrs. Powell, il en adopta les trois fils et les emmena au Cap. Dans la guerre déchaînée par l'Allemagne, l'aîné, capitaine Harry Powell, fut tué près d'Ypres; le second, major Fred Powell, deux fois blessé en Asie et décoré de la croix militaire; le troisième, Bruce Powell, ingénieur dans l'Afrique du Sud, vint à Londres offrir ses services et obtint une commission dans l'artillerie. C'est probablement aux obsèques de Sir Robert Ball, le 6 décembre, 1913, que Gill prit le germe de la maladie à laquelle il succomba. Très religieux, il avait choisi dans les ruines de l'ancienne cathédrale Saint-Machar, à Aberdeen, l'emplacement de son tombeau.

Heureux directeur sur qui l'on a pu écrire un volume entier d'anecdotes toutes à son honneur.

Gill, comme Tycho-Brahé, comme Bradley, a fait progresser l'astronomie de précision. En dehors des théoriciens, il fut sans doute le premier astronome de son temps. Je n'oublierai pas en quels termes M. Paul Cambon m'avait promis de demander que le Roi l'autorisât à recevoir la cravate de commandeur de la Légion d'honneur. Gill en fut heureux; c'était de notre part un témoignage de profonde reconnaissance. B. Baillaud.

SUGAR AND THE TINNED FRUIT INDUSTRY.

(1) *A Handbook for Cane-Sugar Manufacturers and their Chemists*. By Dr. G. L. Spencer. Fifth edition, partly rewritten and enlarged. Pp. xv+529. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 15*s*. net.

(2) *The Canning of Fruits and Vegetables Based on the Methods in Use in California, with Notes on the Control of the Micro-organisms Effecting Spoilage*. By Justo P. Zavalla. Pp. xii+214. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s*. 6*d*. net.

(1) DR. SPENCER has largely rewritten this handbook, and it is now well adapted for the use of those in charge of the large central factories which have become such a marked

feature of the cane-sugar industry. As most sugar factories in the tropics have chemists in control, or at least managers who have some knowledge of chemistry as applied to sugar manufacture, the author seems to have been unnecessarily generous in devoting space to the description of common apparatus and customary methods of analysis. The opportunity might have been taken to direct attention to new sources of supply of apparatus which have become available since the war. No chemist, even in a neutral country, can wish to return to the pre-war dependence on one country for supplies of these materials. Heating appliances for laboratory use are often a difficulty in the tropics, but the author only refers to electrically heated plates and to an alcohol burner. Where current is available, electrically heated water-baths of the type readily obtainable in this country are often preferable to hot-plates, and where current is not available, petrol-air Bunsen burners are probably the best substitute. There must be few parts of the tropics where petrol is not obtainable, and there are British machines for producing the petrol-air mixture which are being used with success in laboratories in the West Indies, Mauritius, and elsewhere.

As regards materials used in sugar manufacture, it is disappointing to find no adequate discussion of the physical properties of sand and kieselguhr, on which the filtering value of these materials depends.

Beyond the statement in a table on p. 5 that the sugar-cane contains 0·2 per cent. of fat and wax, there is no reference to sugar-cane wax, although this may become an important by-product of the sugar-cane industry in the future, and is, in fact, already a commercial article. Another useful addition to the handbook would be a *résumé* of recent work on the improvement of sugar-canes, on which so much work has been done in recent years.

Some of these omissions are perhaps due to the fact that although the book appeared in 1916, it seems to have taken at least a year to pass through the press. The book is well produced on good paper, but it is difficult to see why 15*s.* net should be charged for a book of this size.

(2) Mr. Zavalla's book deals with one of the chief industrial uses of sugar, viz. the "canning" of fruits. It is provided with an introduction by the Dean of the College of Agriculture of the University of California, who begins by saying that "human beings may be traced in almost any part of the globe through the tin cans which they leave behind them," and ends with the hope that the labours of the author will contribute to "the realisation of a uniform and satisfactory food supply for the human race." Probably no one but a citizen of the United States could take the "canning" industry so seriously as all that. Mr. Zavalla describes the processes and plant used in preserving fruits and vegetables in California, from the making of the cans to the construction of the wooden cases in which the tins of preserved fruits and vegetables are shipped. He also discusses and gives a good deal of useful information on the micro-organisms which are found in spoiled tinned goods. This portion of the book would be worth separate and more fundamental treatment by a competent biologist who has given special attention to the subject. The book will, no doubt, be useful to those engaged in this industry, which is rapidly assuming large dimensions and bids fair to become of great importance in British tropical and subtropical colonies.

OUR BOOKSHELF.

Herbert Spencer. By Hugh Elliot. (Makers of the Nineteenth Century Series.) Pp. vi+330+1 portrait. (London: Constable and Co., Ltd., 1917.) Price 6*s.* net.

This is a vigorous and discriminating account of Herbert Spencer's contributions to modern intellectual development. It is written by one who saturated himself with Spencer's doctrines (and read all his works) when on service in the South African War, and has had the endurance to repeat the experience since 1914, with the bitter conviction that if Europe had followed Spencer the present war could never have occurred. "The spirit of Treitschke has triumphed over the spirit of Spencer—the metaphysics of Germany over the common sense of England."

Mr. Elliot's earlier discipleship has lost its dogmatism, but his admiration remains strong for the last of the great nineteenth-century apostles of reason and liberty. As is well known, Spencer expressed the larger and better part of his personality in his works, as an artist might in his paintings, and Mr. Elliot recognises this in his biographical sketch. There is a convincing unity—better, we think, than heretofore—in the picture which the author gives us of the synthetic philosopher. "Evolution and Liberty are the two guiding stars of Spencer's philosophy," and in his exposition Mr. Elliot develops the thesis that Spencer was a man of very strong natural penetration, who formed his theories first and established, or sought to establish, them by induction afterwards—which is, truth to tell, a very common mode of scientific procedure.

For much that Spencer achieved, for instance, in making the evolution-idea organic in all our thinking, a new generation is already forgetting to be grateful; many of his arguments, as this appreciation (which has the true Spencerian spirit) well shows, have lost their cogency; some of the foundation-stones, such as the transmissibility of individually acquired somatic modifications, have not borne the weight of the superimposed structure. But we share with the author of this effective and interesting book the hope that one of the rhythms of intellectual opinion spoken of in the "First Principles" may bring many—especially those whose thinking needs vertebration—back to a Spencerian study of Spencer's works. A good introduction is here to hand.

A Sylow Factor Table of the First Twelve Thousand Numbers, giving the Possible Number of Sylow Sub-Groups of a Group of Given Order between the Limits of 0 *and* 12,000. By H. W. Stager. Pp. xii+120. (Washington: Carnegie Institution of Washington, 1916.) Price 4.50 dollars.

THE main object of this publication is to answer the question: Given n, the order of a group, what are the possible orders of such Sylow sub-groups as it contains? This amounts to finding all divisors of n which are of the form $p\ (kp+1)$, where p is prime. For each n up to 11,999 the table gives the complete resolution of n into its prime factors; and the values of k (other than 0 and 2, which do not require entering) corresponding to each prime factor. Each prime value of n is entered in the body of the table in the form p_t; for instance, the entry p_{627} under 4639 shows that the latter is the 627th prime in order of magnitude, taking $p_1=1$. It is obvious that, apart from its special purpose, this table will be very useful to arithmeticians; every reasonable precaution seems to have been taken to make it accurate, and fortunately the table is of such a kind that every single entry can be tested with very little trouble, and any misprint almost certainly detected, unless a number n has been entered as prime, when really composite. Cases where $p\ (kp+1)=n$, and not merely a divisor of n, are noted, such numbers are called Ps by the compiler—for instance, $1074=3\ (3 \cdot 119+1)$, so 1074 is a P. On pp. xi and xii is a list of these numbers (1–12,229) in their natural order; and there are interesting tables and graphs on the distribution of P numbers and primes. Supposing that $\phi(n)$ means the number of primes not exceeding n, and $\psi(n)$ the number of P numbers not exceeding n, the tables suggest that when $n \to \infty$ the ratio $\psi(n)/\phi(n)$ converges to a definite limit not very different from e; of course this is a mere guess that might occur to anyone, but at any rate to find a formula for $\psi(n)$ analogous to Riemann's for $\phi(n)$ would be an interesting problem. It may not be superfluous to add that the table does not profess to enumerate *actually existent* Sylow sub-groups for different values of n.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Aeroplanes and Atmospheric Gustiness.

THE question which Prof. McAdie raises in his letter in NATURE of April 12 is how to measure the unsteadiness of the air as it affects an aeroplane. Among those connected with flying the term "bumpiness" is used to express the unsteadiness of the air as it affects an aeroplane, and, in the absence of a better word, this may be used here. The problem is, then, to measure the "bumpiness" of the air by meteorological means.

As Prof. McAdie points out, gusts may occur in any direction, but gusts in different directions will not equally affect an aeroplane, those in a vertical direction having the greatest effect. There is evidence to show that the fluctuation in velocity of any individual portion of air is, on the average, roughly the same in any direction, so that, in view of the greater effect of vertical gusts, the fluctuation of the wind, as given by an anemometer, may give entirely erroneous indications of the "bumpiness." The best example of this is in the middle of a hot summer day, with a light wind, and sky partly covered with small cumulus clouds (themselves an indication of vertical currents). Under these conditions, the variation shown by an anemometer may be less than three metres per second, but the air will be very "bumpy" for an aeroplane.

On sunless days, with strong winds, the air is "bumpy" on account of the eddy motion set up by friction with the surface of the ground. If the conditions be the same, the fluctuation is roughly proportional to the mean velocity of the wind, but under different conditions—*e.g.* between night and day—the fluctuation may be very different for the same strength of wind. When it is remembered that the mean velocity of the wind does not in itself affect an aeroplane when flying (except as regards getting from place to place), it will be seen that the mean velocity of the wind should not enter into measurements of the "bumpiness" of the air. Further, the gustiness of the air near the ground is of little importance, except in getting off and landing, and also it cannot be taken as an indication of the "bumpiness" of the air at a height.

To obtain satisfactory information, it would be necessary to measure the fluctuation of velocity in three directions and at various heights. Several methods have been devised for obtaining the vertical velocity, as well as the horizontal velocity and direction, near the ground; to obtain such data at a height is very much more difficult.

The "bumpiness" of the air might be measured by an accelerometer carried on an aeroplane; but this would not be satisfactory to the meteorologist, since it would be difficult to discriminate between vertical currents and horizontal gusts. It may be pointed out that by the use of both a gravity-controlled and a spring-controlled air-speed indicator, this is at least theoretically possible.

If we suppose a satisfactory means of measuring the "bumpiness" to have been devised and standardised, it would be possible to compare the average "bumpiness," say, at one place with that at another, from which, no doubt, some useful information could be obtained. But to make real advance in this part of meteorology, it is necessary to go further and endeavour to find the real structure of the atmosphere and the causes which may give rise to this structure. It is, therefore, to be hoped that the work of meteorologists interested in this branch of the subject may be devoted more and more to these fundamental problems of cause and effect, rather than to the making and tabulation of routine observations, other than those made with the definite object of throwing light on some particular problem. GORDON DOBSON.

Farnborough, April 16.

IN reply to Prof. Alexander McAdie's request (NATURE, April 12) for a means of recording gustiness, I venture to throw out the suggestion that this might be done by observing what in German is called "wimmern." "Hoert Ihrs wimmern hoch vom Thurn? Das ist Sturm." This variation in the sounds heard from church bells during gusty weather is due to the irregular velocities in the atmosphere. That part of

a whirl of air which moves in the same direction as the sound will increase the pitch of the note heard, and *vice versâ*. If an instrument could be devised for recording rapid but slight changes of pitch of musical notes, a fairly accurate estimate of the irregularities of atmospheric velocities could be obtained.

C. E. STROMEYER.

Lancefield, West Didsbury,
April 15.

Gravitation and Thermodynamics.

As pointed out by Sir Oliver Lodge in NATURE of April 5, the case I cited of a disc pivoted about its centre of mass and started in motion does not lead to perpetual motion in the ordinary sense. But, as it seems to me, there will be long-sustained, oscillatory, motion. On rotating the disc by a small angle, the descending half will gain, and the ascending half will lose, heat. A turning-moment will arise, and will increase until the angle turned is $\pi/2$. It will then decrease until, when the angle turned is π, the moment is nil. This position gives the condition, quoted by Sir Oliver Lodge, of thermal symmetry about the vertical diameter of the disc. As the disc continues to rotate, due to its momentum, a moment in a reverse sense will be set up, so that when the whole rotation is nearly 2π, the rotation will be reversed. We shall thus obtain an oscillatory motion, long sustained if small friction is involved. In the final position the disc will have rotated from its initial position by angle π. Such a result would be phenomenal, since the mere act of rotating the disc by an infinitesimal angle would, in effect, convert a condition of neutral, into one of unstable, equilibrium.

Dr. Todd has suggested that this peculiar effect would not arise if $\partial\theta/\partial r$ is positive. We should then have the remaining peculiar effect, viz. a condition of neutral equilibrium would by a rotation be converted into one of stable equilibrium. Will this proposal satisfy philosophers?

P. E. SHAW.

Floating Earths.

I SENT Dr. Leaf's letter on "Floating Earths" (NATURE, March 15) to M. Salomon Reinach, and append his answer, which, I think, partly explains the matter.

J. OFFORD.

94 Gloucester Road, South Kensington, S.W.7.

DEAR MR. OFFORD,—

You won't build on uncertain texts. Dr. Leaf translates "in the case of an islet in Tyrrhenia," reading *νησίς*, which is corrupt; I prefer *γῆ τις* (Corey), a certain variety of earth in Tyrrhenia—the remainder concerning natural science, excepting *ᾗ τὰ ἀργυρώματα ἐκμίττεται*, words which I take in the "trivial meaning."—Yours truly,

S. REINACH.

Musée National, Saint-Germain,
Le 4 avril 1917.

The New Food Orders.

IN my article in NATURE of April 12 there were inadvertently omitted, probably by myself, some words which make one of my suggestions an absurdity. In reference to the meat ration of the Army, what I meant to say was that "*a part* of the large meat allowance might, with advantage, be replaced by its equivalent in energy-value of carbohydrate."

W. M. BAYLISS.

EMPIRE DEVELOPMENT AND ORGANISATION.

THE final report of the Royal Commission on the natural resources, trade, and legislation of certain portions of his Majesty's Dominions has recently been issued and presented to both Houses of Parliament. The commission came into being in consequence of a resolution passed by the Imperial Conference in 1911. The members were appointed in April, 1912, six representing the United Kingdom, and one each the self-governing Dominions of Canada, Australia, New Zealand, the Union of South Africa, and Newfoundland. India, the Crown Colonies, and the Protectorates were not included.

The sittings of the commission ended, as they began, in London. In the interval the commissioners made four tours: the first to New Zealand and Australia, the second to the Union of South Africa, the third to Newfoundland and eastern Canada, and the fourth to central and western Canada. They visited every capital of every State or Province in each of the Dominions, and took evidence in all the most important cities. They say:—

In the course of this period we have travelled for many tens of thousands of miles to, through, and from the self-governing Dominions of your Majesty's Empire. In every district of this vast area we have done our utmost, collectively and individually, to make ourselves acquainted with its characteristics, its history, and its aspirations, as we hope, and indeed believe, not without success. We have also had the opportunity of hearing personally the opinions of every section of its population upon the problems upon which we have been engaged. It is therefore with a certain confidence as to their value that we present our unanimous conclusions for your Majesty's consideration.

It is to be noted, however, that in May, 1915, the Government of the Commonwealth of Australia withdrew its representative from the commission, and the final report does not contain the signature of any representative of that Dominion. No reason is given for this action on the part of Australia.

The main object of the commission was to inquire into, and report upon, (*a*) the natural resources of the five self-governing Dominions and the best means of developing them; (*b*) their trade with the United Kingdom, each other, and the rest of the world; and (*c*) their requirements and those of the United Kingdom in regard to food and raw materials, together with the available sources of supply. Broad as the scope of this inquiry was, it could not be kept within the prescribed limits. The commissioners say:—

During the whole course of our investigations . . . we have been conscious of two strong and impelling impressions.

First, for Empire purposes no survey can be complete without including India, the Crown Colonies, and the Protectorates. In themselves, and even as now developed, they form too vital and important a part of the Empire to be left out of present calculations. But it is plainly evident that their potentialities, measured by any fair standard, are immense,

and that their future contributions to the Empire's strength and greatness will far surpass those of the past. These parts of your Majesty's oversea possessions are vitally linked with the self-governing Dominions; the destinies of all are interwoven.

Secondly, we have been equally strongly impressed by the almost infinite variety of Empire domain, the extent of its area, the inequality of distribution of its population, and the disconnected character of its governing and directing machinery.

In other words, the only practicable subject of investigation turned out to be the British Empire itself. Successive interim reports on the five Dominions, following on the four tours undertaken by the commission, have already appeared.

The opening chapters of the final report are historical and descriptive, and show the leading characteristics of the Dominions and the development of their trade. They analyse briefly their chief resources and prospects of expansion. The survey falls under five heads, viz. agricultural and pastoral resources, minerals, forests, fisheries, and water-power. They describe also some of the chief measures for controlling and utilising natural resources for the common benefit which have been taken by the Governments concerned during the war, and lead up to two chapters outlining a policy in respect of the scientific development of natural resources for the future. Migration and its intimate bearing on the problems of development of the Empire forms the subject of the next chapter, succeeded by three dealing with Imperial communications. In the first of these stress is laid on the need for deeper harbours and the co-ordination of harbour depths in order to facilitate cheap, speedy, and efficient transport. Recommendations for developing fast Imperial services on several of the most important trade routes of the world are made. Ocean freight rates and the respective liabilities of shipowners and shippers under bills of lading come under consideration. In the second the handling of produce brought to, and distributed from, the ports of the United Kingdom is passed under review, while in the third cable and wireless services between the United Kingdom and Dominions are discussed and suggestions made for their improvement. Questions of commercial importance form the subject-matter of the next two chapters, and in the final one the commissioners criticise the past and existing deficiencies in Imperial organisation and outline a scheme for the creation of an Imperial Development Board, charged with the duty of undertaking and promoting the development of the natural resources, trade, and communications of the Empire.

As a preliminary to considering the conservation and development of natural resources in the future, the commissioners point out that before any adequate measures can be taken towards this end a preliminary survey is needed of the relation between Empire production and Empire requirements throughout the whole range of the articles required for the sustenance and well-being of the people, for the maintenance of industry, and for the production of munitions of war. As they say truly, no such survey has ever been undertaken. They go on to point out that it should divide the necessary materials of trade and commerce into the following three main categories:—

(1) *Materials of which the world's requirements are mainly or wholly produced within the Empire.* As instances, it may be mentioned that Canada produces much the largest proportion of nickel, cobalt, and asbestos, and, in conjunction with India, of mica. New Zealand produces practically the only supply of kauri gum and phormium fibre. The Union of South Africa has a virtual monopoly of diamonds and ostrich feathers. India has a monopoly of jute, while the West African Colonies yield the major portion of the world's supply of palm-nuts and palm-kernels, and the Eastern Colonies of plantation rubber. The British Empire produces from 40 to 45 per cent. of the world's total supply of wool, and more than 60 per cent. of the world's output of gold. To take one instance only of how little a valuable mineral is worked up into a manufactured article in the country of its origin, it may be mentioned that, although Canada is practically the only producer of raw asbestos in the world, the United Kingdom is largely dependent on outside sources, especially the United States, for the manufactured asbestos which it requires, and that even Canada imports manufactured asbestos to the average value of 70,000*l.* per annum.

(2) *Materials of which the Empire's requirements are approximately equalled by Empire production.* Examples of products falling within this category are wheat, butter, cheese, and wool. In certain cases, instances of which are zinc, tungsten, and monazite, the commissioners indicate the necessity for special action in order to secure the control and utilisation of Imperial supplies for the Empire's use.

(3) *Materials of which the world's requirements, and with them those of the Empire, are mainly produced and controlled outside the Empire.* Most careful inquiry is obviously needed in regard to substances of this kind, instances of which are cotton, petroleum, nitrates, and potash. Investigation should take two directions: (*a*) the possibility of finding new sources of supply within the Empire, and (*b*) the possibility of finding substitutes within the Empire. Means of preventing waste in existing sources of supply of all minerals should also be investigated.

The commissioners recommend that the responsibility for a survey and investigations on the lines indicated should be entrusted to a new Imperial Development Board. They say:—

We believe the time has come when a body should be created which could be referred to at any time and by any of the Governments, in order to smooth the path of Imperial development. There is, indeed, both scope and need for a new Imperial Development Board, which, without displacing any existing body, would devote its energies and experience to a continuous survey and consideration of Empire resources and opportunities and to a study of the best means of co-ordinating Empire effort for the development of these resources, for the extension of Imperial trade,

and for the strengthening of Imperial lines of communication. It would be impossible to exaggerate the significance and influence of such a board, composed, as it should be, of men possessing an intimate knowledge of the Empire and its resources, in constant consultation and collaboration, on the watch for every opportunity, and alive to every possibility. . . . The primary condition of this new board must be that it should not encroach upon the political or administrative machinery of any of the self-governing parts of the Empire. In other words, it should be purely advisory in its initial stage. We are not prepared to suggest that at its inception any specific administrative functions should be assigned to it, but equally we hesitate to restrict the future activities of a new and, to some extent, experimental organisation. If, at some future time, the Government of the Empire should, either through the Imperial Conference or otherwise, desire to delegate any administrative duties to it, we see no inherent difficulty in giving effect to such a wish.

With regard to the constitution of the new organisation, the commissioners recommend that its numbers should be kept as low as possible, with the view of increasing its efficiency, and that its members should be required to give their whole time to the work. They suggest seven representatives for the United Kingdom, India, the Crown Colonies, and the Protectorates, and one each for the five self-governing Dominions. They recommend further that the board should carry out the research work required for the survey in the following manner:—

(*a*) In respect of the United Kingdom, through the recently formed Department for Scientific and Industrial Research, the National Physical Laboratory, etc.

(*b*) In respect of the self-governing Dominions, through the now existing scientific departments and the committees for research which are being set up in the Dominions.

(*c*) In respect of India, the Crown Colonies, and the Protectorates, through the local scientific departments and the Imperial Institute.

Finally, they say:—

The unanimity which is shown in all our reports, and has been maintained throughout the deliberations of the first Royal Commission comprising representatives of all the self-governing communities of your Majesty's Empire, is, we venture to think, of hopeful augury. We make bold to assert, after five years' experience throughout the Empire, that the spirit of co-operation, so splendidly demonstrated in war, will be succeeded, after peace is declared, by absolute concord in the great task of reconstruction and development.

It is quite certain that no Blue Book of such momentous importance as this is to the development of the resources of the British Empire as a whole has ever before been published. Great as the preoccupations of the Government must be at the present time, they should not be allowed to prevent the most weighty consideration being devoted to the recommendations unanimously reached by the commissioners. It may be doubted whether so favourable an opportunity for giving effect to them by legislative enactment will ever occur in the history of the Empire again.

H. C. H. C.

NATIONAL REFORMS IN EDUCATION.

An enthusiastic welcome was extended to the speech of the President of the Board of Education, Mr. H. A. L. Fisher, on introducing the Education Estimates on Thursday last. Whatever be the motives which prompted it, whether they arose merely from considerations relating solely to the industrial and commercial equipment of the nation, or from the need for more effective military preparation, or from a tardy conviction that the essential well-being of the people demanded a much more adequate provision for the due training of all the children, they are a gratifying index of the changed attitude of Parliament on this vital subject, and a sign, we hope, that the Presidency of the Board will always be occupied by someone familiar with educational problems and not be a purely political appointment as formerly. However distasteful the thought may be, there is lying at the back of men's minds the conviction that the industrial, commercial, and military position of Germany is due in the main to the sedulous cultivation, through many generations, from the days of Humboldt downwards, of the intellectual life of the nation, and that though we do not desire slavishly to imitate her methods or to pursue her ideals, yet we have arrived at last at the conviction that we cannot any longer, if we would preserve and advance our pride of place in the world, afford to ignore and waste the most vital asset of the nation, namely, the due cultivation, bodily, mentally, and spiritually, of its child life among all classes.

We are, according to Mr. Fisher, spending annually from all sources, public and private, some forty million pounds sterling on the education of the people of England and Wales (which large sum contrasts strangely with the first Parliamentary grant for education of 20,000*l.* in 1834, continued annually until 1840, for the building of elementary schools); and yet we are not providing effectively for their adequate training. Many more millions need to be spent before that purpose is fully assured, and so the President of the Board comes forward with a demand for nearly four millions in advance of the Estimates of 1916-17, which are to be applied chiefly to remedy the low and uneven remuneration of the teachers, both elementary and secondary, throughout the country, and to establish a scheme of pensions for secondary-school teachers; and measures are devised so that this important object may be secured with the willing co-operation of the local authorities. It is strongly felt that it will be impossible to secure any effective measures for the improvement of education unless the supply of suitably trained teachers can be adequately maintained. It is further the purpose of the Board to encourage the establishment of a much larger number of scholarships, with due maintenance grants, enabling duly qualified children to proceed to higher stages of instruction in secondary schools and universities, and also to provide advanced courses in central schools for children remaining at school until the close of the legal age of attendance.

All these urgent reforms can be instituted under the regulations governing the policy of the Board, and require no special legislative sanction. They appeared to receive the warm assent of the House, but it was the closing sentences of Mr. Fisher's statement which aroused the deepest attention, wherein he adumbrated the lines of a Bill for the reform of education, of which the measures he had already indicated were but an instalment, which he hoped shortly to introduce. He proposed in this measure, having regard to the deplorable waste of child life, to make provision in nursery schools for children under five; to secure for every boy and girl a full period of instruction until the fourteenth year; to provide for more satisfactory education in rural areas; to secure the proper co-ordination of every type and grade of school throughout the country, and to require county authorities, either separately or in combination, to make complete and progressive schemes of education for their areas; to make better and more complete provision for adolescent education so as to ensure for young persons engaged in employment a fuller intellectual, moral, and physical discipline; and, finally, as soon as occasion serves, to consider the problem of the universities with the view of meeting the urgent need for promoting free and independent post-graduate research and the higher forms of learning in the universities of this country, together with a liberal provision of scholarships with this object. We must await the introduction of this Bill before we can discuss fully the actual means proposed to give effect to these measures of reform, but it is well that a man speaking with the high authority of the President of the Board of Education and with the full knowledge of his colleagues in the Government is bold enough to set them forth as ideals to be shortly attained, and his effort demands the fullest and most earnest support of every enlightened authority throughout the kingdom. Not until the whole fabric of education is brought under review and each department of it made effective and duly related can its full value be realised and the highest forms of education be ensured on sound and satisfactory lines.

CO-OPERATION IN RUSSIAN AND BRITISH SCIENTIFIC UNDERTAKINGS.

During the past year the question of a closer relationship between British and Russian savants has been the subject of several meetings of different learned bodies in Russia, chiefly in Petrograd. Particulars cannot here be given, but a short account of the more important developments likely to give some positive results may be of interest.

In April, 1916, the Minister of Public Instruction invited a number of universities to state the measures which, in their opinion, would lead to the promotion of closer intercommunication between the Russian and the British scientific worlds. The council of the University of Petrograd discussed the matter in May, and stated in reply to the Minister in June last that a closer relationship would be desirable not only with British, but also with French men of science and those of other allied countries. This object could be best attained by forming an international association of universities and academies of sciences, which would promote mutual knowledge of scientific work and activity, the organisation of international scientific undertakings (expeditions, publications, etc.), and the dissemination of the languages of the members of the association.

Such an organisation could easily undertake to bring about such measures as: (*a*) delegation of professors and academicians to the chief universities of allied countries to give courses of lectures in the language of the country (not their own) and to promote personal intercommunication with foreign men of science; (*b*) mutual admission of students of science to the universities and scientific institutions of allied countries for the purpose of advancement of their scientific studies and the acquaintance with the scientific world of a given country; (*c*) organisation of congresses in separate branches of learning for deliberating on questions of international scientific and inquiry undertakings, and of pedagogy; (*d*) organisation of yearly reports on the scientific literature of a given country, to be printed in special periodicals; (*e*) reports on the scientific activities of different institutions and of persons working in these institutions. To promote the foundation of the International Association it is necessary first of all to form an association of Russian scientific bodies, which should undertake the necessary steps to begin the publication of yearly reports on Russian scientific literature in special periodicals. It is also necessary, as a second preliminary measure, to create at the Russian Legations abroad and at the British, French, and other Legations in Russia some sort of scientific attaché, who would be at the disposal of men of science.

The matter was then taken up by the Imperial Academy of Sciences, which considered the whole question at a plenary meeting on October 15 (28), 1916, after it had been reported upon by a committee composed of the permanent secretary of the Academy, S. Oldenburg, and the academicians N. Kondakov, P. Vinogradov, and P. Walden. The report of this committee was adopted at a plenary meeting, and was afterwards presented to the Minister of Public Instruction. It laid great stress on the necessity for mutual cognisance of scientific work and scientific undertakings of Russia and Great Britain. To this end the academy formed a committee of specialists charged with the editing of two scientific periodicals devoted to physico-mathematical and biological sciences, printed in Russian and French. These periodicals will contain a summary of scientific work of Russian savants. It is proposed further to make more accessible British scientific publications and books, which it is very difficult to obtain at present,[1] by way of new

[1] For instance, only *unbound* books are now allowed to enter Russia, whereas British books are always sold bound. I am obliged to order them with the *covers torn off*.

regulations and perhaps subsidies to leading booksellers. The other measures proposed are identical with those contained in the memorandum of the University of Petrograd.

The Academy of Sciences proposes further to call together soon a special congress of representatives of universities, learned societies, and other learned bodies in order to discuss the practical ways and means towards promoting a closer scientific relationship with Great Britain.

B. MENSCHUTKIN

NOTES.

THE secretary to the Reconstruction Committee has favoured us with the following list of the members of the committee: The Right Hon. the Prime Minister (chairman); the Right Hon. E. S. Montagu, M.P. (vice-chairman); Prof. W. G. S. Adams; Mr. J. R. Clynes, M.P.; Sir A. M. Duckham, K.C.B.; Mr. Richard Hazleton, M.P.; Major J. W. Hills, M.P.; Mr. Thomas Jones; Mr. P. H. Kerr; Dr. Marion Phillips; Mr. B. Seebohm Rowntree; the Most Hon. the Marquess of Salisbury, K.G., G.C.V.O.; Mr. Leslie Scott, K.C., M.P.; Sir J. Stevenson, Bart.; Mr. J. H. Thomas, M.P.; and Mrs. Sidney Webb.

A SUMMARY of the Rockefeller Foundation grants for 1916 is contained in a pamphlet published in New York on March 19. The total amount of the grants made during the year was 1,649,820*l*. The largest grants were for war relief, and these reached 518,000*l*. in 1916, making 836,400*l*. since the beginning of the war. To the National Health Board 122,300*l*. was given, chiefly for the relief and control of "Hookworm" disease in the southern States, several Latin-American countries, and in certain British colonies. The board has also made a survey of the principal endemic foci of yellow fever, and experiments for the control of malaria. The China Medical Board received during the year 213,630*l*. for the promotion of medical education in China. Among the largest of the single contributions of the Foundation to outside agencies was the gift of 200,000*l*. to the New York Palisades Interstate Park Commission towards the sum necessary for the enlargement and improvement of the Palisades Interstate Park.

PROF. EMIL VON BEHRING, whose death was announced in NATURE of April 5, was born at Hansdorf in 1854. He received his professional education at the Army Medical College, Berlin, obtaining his doctor's degree in 1878. He afterwards served in the Army, and in 1889 was appointed assistant at the Institute of Hygiene, Berlin, being transferred later, in 1891, to a corresponding post in Koch's Institute for Infectious Diseases. He there commenced his researches on immunity in diphtheria, culminating in 1893 in the discovery and preparation of diphtheria antitoxin. For this work he received prizes from the Académie de Médecine of Paris and the Institute of France. In 1894 he received the title of "Professor" in recognition of his scientific work, and was appointed to the chair of hygiene in the University of Halle. In the following year he accepted a call to Marburg, where he held the post of professor and director of the Institute of Hygiene. In 1895 the title of Medical Privy Councillor was conferred upon him. Although Behring's name is best known in connection with the discovery of diphtheria antitoxin, he also carried out researches on tuberculosis, ascribing the major part of tuberculosis in children to infection from tuberculous milk, and prepared a form of tuberculin, "tulase," by the action of chloral on tubercle bacilli, which, however, does not appear to have more value than other forms of tuberculin. In 1913 he published an investigation on diphtheria bacilli carriers, and proposed to treat these with a mixture of diphtheria antitoxin and diphtheria toxin. With Löffler and Ehrlich, who have also died during the course of the present war, Behring must be regarded as one of the band of pioneers of modern bacteriology and immunology.

THE permanent committee for the study of the natural resources of the Russian Empire, formed by the Petrograd Academy of Sciences in 1915, has begun to publish the great work "Natural Productive Forces of Russia," which is intended to give, so far as it is at present possible, a complete review of the natural wealth of Russia, destined to play an important part in the future economic development of the country. This work will form six volumes—about 2400 pages large octavo—and is being printed in the Government printing office. The contents of the volumes will be as follows: Vol. i., "Utilisation of the Force of Wind." This volume is being prepared by a special sub-committee (president, M. A. Rykačev), and will be devoted to (1) the necessary meteorological data; (2) wind-motors, their best types, cost, and uses. Vol. ii., "White Coal"; a sub-committee under the presidency of V. T. Vernadskij will give (1) a geological and hydrological description of different regions of Russia; (2) characteristics of separate rivers and data for the utilisation of their water-power. Vol. iii., "Artesian Waters," by a sub-committee presided over by N. T. Andrusov. Contents. (1) Geological data in connection with water-bearing strata of different regions of Russia; (2) artesian bores already in existence and the future possibilities. Vol. iv., "Useful Minerals," is prepared by the geological committee and edited by K. T. Bogdanovič. It will give trustworthy information about the occurrence, localities, quantities, and properties of different ore deposits and important minerals of Russia. Vol. v., "Plants," edited by a sub-committee of specialists under T. P. Borodin: botanico-geographical review of the Russian Empire and a description of all the cultures of different regions in relation to agriculture and the utilisation of plants. Vol. vi., "Animals," edited by V. K. Bražnikov and E. F Liskun: (1) Systematic survey of the animal representatives, wild and domestic; (2) utilisation of wild and domestic animals. The edition is limited to 5000 copies; the subscription price for all the six volumes is 10 roubles (=14*s*. at the present rate of exchange). The committee for the study of the natural resources of Russia has also edited during 1916 twelve monographs, under the title of "Materials for the Study of the Natural Productive Forces of Russia," dealing with ore deposits of different metals, medicinal plants, clays, etc.; and about a hundred more are in course of printing and preparation. These monographs are published by the Imperial Academy of Sciences.

THE Hanbury gold medal for 1917 has been awarded to Prof. H. G. Greenish, professor of pharmaceutics to the Pharmaceutical Society of Great Britain.

THE Fothergillian medal of the Medical Society of London for 1917 has been awarded to Sir Leonard Rogers, of the Calcutta Medical College, for his work on dysenteries, their differentiation and treatment.

THE treasurers of the Middlesex Hospital have received a donation of 1000*l*. from Sir John and Lady Bland-Sutton and 250*l*. from Mr. G. Vaughan Morgan in response to the appeal on behalf of the research fund of the pathological institute of the hospital.

The seventh May lecture of the Institute of Metals will be delivered at the Institution of Civil Engineers on Thursday, May 3, at 8.30 p.m., by Prof. W. E. Dalby, on "Researches made Possible by the Autographic Load-extension Optical Indicator."

The Jacksonian prize of the Royal College of Surgeons of England for 1916 has been awarded to Mr. E. W. H. Groves for his dissertation on "Methods and Results of Transplantation of Bone in the Repair of Defects caused by Injury or Disease." The subject for the Jacksonian prize for 1918 is "The Injuries and Diseases of the Pancreas and their Surgical Treatment."

The death is announced, in his seventy-fourth year, of Dr. H. B. Cornwall, professor of applied chemistry and mineralogy at Princeton University from 1873 to 1910. He previously held posts on the faculty of Columbia University, and was for a short time the superintendent of a mining company in Mexico. He was the author of a manual of blow-pipe analysis and other works.

The next informal meeting of the Chemical Society will be held at Burlington House, W., on Thursday, May 10, at 8 p.m. Owing to ill-health, Dr. Horace T. Brown will be unable to deliver, on May 17, his lecture entitled "The Principles of Diffusion: Their Analogies and Applications" as previously announced. The lecture has been postponed for the time, and the usual ordinary scientific meeting will be held on that day.

We learn from the *Morning Post* that Mr. W. P. Fraser, plant pathologist, of Macdonald College, has been appointed to investigate the problem of grain rust on the prairie provinces of Western Canada. The Canadian Minister of Agriculture, the Hon. Martin Burrell, has been devoting special attention to the problem, and two well-equipped laboratories have been built on the experimental farms at Brandon and Indian Head.

The death is announced of Sir Albert J. Durston, Engineer-in-Chief of the Navy from 1889 to 1907. We learn from the *Times* that Sir Albert was born in 1846, and was educated privately, in Portsmouth Dockyard, and at the Royal School of Naval Architecture, South Kensington. He entered the Royal Navy in 1866, became chief engineer in 1877, chief inspector of machinery in 1893, and chief engineer at Sheerness and Portsmouth in 1881. During his administration of the engineering department there were introduced the water-tube boiler, the turbine system of propulsion, and the use of oil fuel—all inventions which made for the increase in engine-power and the speed of the ships of the Fleet which has been so noticeable and valuable during the war.

We learn from the *British Medical Journal* that Surgeon-General Sir William Taylor, K.C.B., late Director-General, Army Medical Staff, died at Windsor on March 10, aged seventy-four. In 1898 Sir William was appointed principal medical officer to the British Army in India and held that post for three years, until he became Director-General of the Army Medical Service on December 3, 1901, in the late stage of the Boer war. On August 21, 1901, he was gazetted honorary physician to the King, and in 1902 received the K.C.B. His *Alma Mater*, the University of Glasgow, bestowed upon him the honorary degree of LL.D. He retired on December 2, 1904, after forty years' service in the Army, during which he had served in six campaigns, and had risen to the highest position open to a medical officer.

At the annual general meeting of the Institution of Civil Engineers held on April 17 the result of the ballot for the election of officers was declared as follows: *President:* Mr. W. B. Worthington. *Vice-presidents:* Mr. J. A. F. Aspinall, Mr. H. E. Jones, Sir John P. Griffith, and Mr. J. A. Brodie. *Other Members of Council:* Dr. C. C. Carpenter; Dr. Dugald Clerk; Col. R. E. B. Crompton; Mr. M. Deacon; Sir Archibald Denny, Bart.; Mr. W. H. Ellis; Sir R. R. Gales; Mr. A. J. Goldsmith; Sir R. A. Hadfield; Brigadier-General B. H. Henderson; Mr. R. W. Holmes; Prof. Bertram Hopkinson; Mr. G. W. Humphreys; Mr. Summers Hunter; Dr. W. H. Maw; Mr. C. L. Morgan; Mr. Basil Mott; Sir H. J. Oram; Mr. F. Palmer; Capt. H. P. R. Sankey; Sir J. F. C. Snell; Mr. E. F. C. Trench; Mr. W. F. Tye; Sir Philip Watts; Mr. E. J. Way; and Sir A. F. Yarrow, Bart. The council has made the following awards for papers read and discussed during the session 1916–17: Telford gold medals to Messrs. G. W. Humphreys and J. B. Ball; George Stephenson gold medals to Messrs. P. V. O'Brien and John Parr; Telford premiums to Messrs. P. V. O'Brien, J. L. Hodgson, W. Brown, and P. M. Crosthwaite; and a Crampton prize to Mr. F. J. Waring.

Mr. Abel Chapman, in the *Scottish Naturalist* for April, demolishes the contention that there are two distinct sub-specific forms of the Brent goose, both of which, according to the most recent text-books, are to be found in the British Islands. The one is supposed to have a light-, the other a dark-coloured breast. Mr. Chapman is of opinion that these differences merely indicate dimorphism. And it would seem that the ornithologists who made the "sub-species" to which he objects have come to the conclusion that Mr. Chapman's interpretation is the right one.

The extreme severity of the weather since January has told heavily on our native birds. One of the first records of this fact is that by Mr. H. M. Wallis in *British Birds* for April. During the February frost, in West Cornwall, he remarks, lapwings haunted the town rubbish-heaps and tiny grass plots in front of suburban houses; finally, they came to the windows for food, but eventually most of them seem to have died from starvation, their dead bodies, dreadfully emaciated, being picked up in gardens, beside roads, and in almost every field. After the lapwings, golden plover, gulls, thrushes, and starlings seem to have suffered most, though many other species are enumerated in his list of dead.

The British Museum (Natural History) has just issued, in pamphlet form, some "Instructions for Collectors," dealing with the preparation of mammal skeletons in the field, with special notes on the collection of specimens of Cetacea. Since the skin of the latter cannot be successfully preserved, special emphasis is laid on the need for careful notes and measurements of carcases before dismemberment. Attention is also directed to the importance of very careful notes as to the colour of the "whale-bone" in baleen whales, and the number and position of the teeth in the "toothed" whales. In all cases, it is remarked, sketches or photographs of the external appearance of a Cetacean should be made before the work of preparing the skeleton is begun. These "Instructions" have been carefully drawn up by Dr. S. F. Harmer, the keeper of the department of zoology, and should prove very welcome.

The insects attacking stored wheat in the Punjab are described, with admirable coloured illustrations, by J. H. Barnes and A. J. Grove in the Memoirs of the

Department of Agriculture in India (vol. iv., No. 6). This paper is especially noteworthy for a discussion of the effect on the insects of inert gases and variations in temperature and moisture, as connected with the respiratory function. Hydrogen kills beetles more rapidly than nitrogen, and nitrogen than carbon dioxide; an increase in temperature causes a shortening of the lethal period. As to the effect of moisture, Calandra and Rhizopertha are destroyed by desiccation, but Attagenus "prefers dry conditions to moist ones."

IT is thirty years since Profs. Tracy and Goff established in the United States the value of tarred paper discs in preventing the access to cabbage-roots of the cabbage-fly (*Phorbia brassicae*) for the purpose of egg-laying. Although the maggots of this insect are among the most destructive farm and garden pests known to us in these islands, British and Irish cultivators who have heard of the American preventive measure have usually derided it. They may perhaps be convinced by the "Report on a Trial of Tarred Felt Discs for Protecting Cabbages and Cauliflowers," which Mr. J. T. Wadsworth publishes in the *Annals of Applied Biology* (vol. iii., 1917, pp. 82–92). From his research, carried out for the Manchester University Department of Agricultural Entomology, it appears that 63 per cent. of unprotected cauliflowers and 13·2 per cent. of unprotected cabbages are lost, as against 5·1 per cent. and 0·2 per cent. respectively of those plants provided with cards. We understand that a local merchant is now putting effective discs on the market.

THE grading for stock-feeding purposes of the various "offals" produced in the milling of wheat has always been a source of much confusion to the farmer and his advisers. It is a common experience for offals sold under a particular name in one district to differ widely, both in general character and in chemical composition, from materials sold under the same names in other districts. The confusion is mainly due to local variations in milling practice, and little success has attended past efforts at standardisation. A substantial advance should now be possible, however, in the light of observations made by Messrs. T. B. Wood and R. H. Adie, which are recorded in the March issue of the *Journal of the Board of Agriculture*. Their results indicate that, excluding the extreme fractions, flour and bran, milling offals may be classified into three "pure grades" (fine middlings, coarse middlings, and pollards) coming from the mills where the intermediate offals are most completely separated, and three "mixed grades" coming from mills where the offals are not so completely divided. The number of samples examined by Messrs. Wood and Adie, though not large enough to establish standard compositions for the "pure grades," was sufficient to demonstrate that these grades are characterised, not only by a limited range in the size of their particles, but by a definite chemical composition. It is suggested that millers should adopt a uniform system of grading and naming their offals, and a simple method of achieving the latter object, whilst retaining the local trade names, is indicated.

MESSRS. STANFORD have just issued a new and enlarged edition of No. 17 of their large-scale war maps; it includes Tournai, Cambrai, and the environs of St. Quentin on the east, and shows the defensive line held by the enemy from the date of the Marne defeat until the opening of the Somme battle; and it also shows the line to which the enemy had been driven by April 17 during the battle of Arras. An interesting feature of this series is the diagrammatic way in which the levels of the land are shown; tints of brown colour distinguish the land lying between sea-level and 125 ft. above, between 125 ft. and 250 ft., 250 ft. and 500 ft., and 500 ft. and 1000 ft. above sea-level; this gives the map-reader an excellent idea of the lie of the country.

IN a Bulletin issued by the Department of Chemistry, Adelaide, the director, Dr. Hargreaves, discusses the practicability of manufacturing cream of tartar in South Australia. Grapes, the source of tartar, are largely grown in the country, but at present all the tartaric acid and most of the cream of tartar used in South Australia are imported from Europe. Experiments showed that a quite satisfactory process was available. The wine lees receive a preliminary roasting at a temperature of 120° to 150° C., which is high enough to decompose the albuminous and organic colouring matters without injuring the cream of tartar; this much facilitates filtration. The cream of tartar is then extracted with hot water, filtered, and crystallised out. There is not a promising field for a large industry, because the total possible production, it is calculated, would not be sufficient to supply the needs of the country. Nevertheless, the available tartar should not be allowed to go to waste as at present, and a start has been made with the manufacture.

WE learn from the *Geographical Journal* for April (vol. xlix., No. 4) that, at the request of the Astronomer Royal, the Royal Geographical Society is collecting information about possible observing stations for the total solar eclipse on May 29, 1919. The eclipse passes over the Amazon basin, the Atlantic Ocean, and the Congo basin to Tanganyika. Possible stations are suggested in the State of Ceará in Brazil, the Island of Principe, the neighbourhood of Libreville in the French Congo, and on the western escarpment of Tanganyika. Between Libreville and Tanganyika the forest conditions preclude the possibility of a station The essential conditions for an eclipse camp are the good chance of clear weather; reasonable accessibility, with means of transport for heavy instruments; available local labour and materials for the construction of huts and the foundations for instruments; and a good supply of pure water for photography. The society will be grateful to any correspondents who may be so good as to send advice in these matters.

IN fulfilment of the international scheme of which it is the centre, the Meteorological Institute of the Netherlands has recently issued copies of a number of records of magnetic disturbance obtained during 1914 and 1915 at De Bilt Observatory. In all, twenty-three magnetic storms are dealt with—twelve from 1914 and eleven from 1915. In each case the record includes thirty consecutive hours, declination, horizontal-force, and vertical-force traces being shown on the same sheet, referred to a common base or time line. The base-line values and the scale values of the ordinates are marked in each case. The disturbances selected afford excellent examples of "sudden commencements," "bays," slow and rapid oscillations, and isolated tooth-like protuberances on the curves. The tendency in the vertical force to be above its normal value during late afternoon hours in times of disturbance is conspicuous in the majority of instances. One or two of the storms selected for 1915 were of considerable size, especially that of June 17–18. The sensitiveness of the horizontal-force and vertical-force magnetographs is unusually high at De Bilt. This enables details of moderate movements to be more readily recognised, but increases the risk of loss of trace during large movements, and makes it more

difficult to prevent interference of traces when three elements are included in a single sheet. Only great care and resourcefulness could have dealt with the difficulties as satisfactorily as has been done in the present case.

In addition to the high prices and short quantities of printing paper now available, strawboard, which is necessary for the binding of books, has risen enormously in price, whilst a famine in that commodity threatens soon to deprive the publishing trade altogether of the power to bind books in cloth. At no distant date, therefore, it is probable that we shall see English books issued with paper covers, a state of things which may continue indefinitely, depending not so much upon the cost of this essential material as the length of time which must elapse, even after the war, before there are again sufficient supplies available. It is clear that in the very near future publishers, binders, and booksellers will have, in regard to the majority of books, to adapt themselves to a new order of things, and the public will have to be satisfied with books issued, as is so widely the custom on the Continent, in paper covers.

Mr. John Murray's new list of announcements contains, among others, "Collected Essays and Addresses," by Sir F. Darwin (some of the subjects dealt with are "Sir Francis Galton," "Sir George Darwin," "The Movements of Plants," "The Education of a Man of Science," and "The Teaching of Science"); a new and revised edition of "The Book of the Rothamsted Experiments," edited by Dr. E. J. Russell, containing a chapter by A. D. Hall on the secondary effects of manures on the soil, and one by Dr. Russell on the production of plant food in the soil; and "A Regimental Surgeon in War and Prison," by Capt. R. V. Dolbey.

OUR ASTRONOMICAL COLUMN.

A New Comet.—In a message to the *Times* of April 20, dated April 19, it is stated that a comet of marked brilliancy had been observed at Sydney. It was seen in the eastern sky at dawn, and Prof. Cooke is said to have described it as a new comet. The position of the comet had not been determined.

Comet *b* 1916 (Wolf).—The following continued ephemeris, for Greenwich midnight, is given by Prof. Crawford in Lick Observatory Bulletin No. 289:—

1917	R.A. h. m. s.	Decl. ° ′	Log Δ	Brightness
April 26	20 21 28	+11 12·2	0·1994	2·81
27	23 55	29·0		
28	26 22	11 45·9	0·1943	
29	28 49	12 2·8		
30	31 16	19·6	0·1892	3·01
May 1	33 43	36·4		
2	36 9	12 53·2	0·1841	
3	38 36	13 9·9		
4	41 2	26·6	0·1791	3·21
5	43 28	43·2		
6	45 55	13 59·8	0·1742	
7	48 21	14 16·4		
8	50 47	32·9	0·1694	3·42
9	53 13	14 49·3		
10	55 38	15 5·7	0·1646	
11	20 58 4	21·9		
12	21 0 29	38·1	0·1599	3·63

The unit of brightness is that on March 5, and the figures given in the last column should be multiplied by 17 to reduce to the unit of brightness on 1916 May 10.

The path of the comet during the above period is through the constellation Delphinus. On May 1 the comet rises about 10.45 p.m. G.M.T. It is now an interesting object in the telescope, but it has been disappointingly faint, and it does not seem very probable that it will become visible to the naked eye.

The distance of the comet from the earth on April 30 will be 144,000,000 miles, and on May 10 136,000,000 miles.

The April Lyrids.—These meteors appear to have been more active than usual this year, and the maximum occurred on April 21. On April 20 Mr. Denning watched a beautifully clear sky at Bristol, and recorded twenty-one meteors in three and a quarter hours; of these, six were Lyrids. On April 21 the sky was overcast at Bristol, but Mrs. F. Wilson reports from Totteridge that the firmament cleared at about 11 p.m. G.M.T., and that thirty-five meteors, chiefly Lyrids, were observed in the two and a half hours up to 13.30 G.M.T. Others must have been missed while the paths of the brighter objects were being registered. The radiant point was at $272° + 34°$, and precisely the same as found independently at Bristol on the previous night. One fireball was observed at Totteridge, and the Lyrids were recorded as very swift and as usually leaving streaks.

On April 22 the weather at Bristol was very favourable after 9.30 G.M.T., but a watch for meteors maintained for about two and a quarter hours yielded only six, half of which were Lyrids.

The conclusion that this important meteoric stream recurs under a very plentiful aspect at periods of about sixteen years is confirmed by this year's observations.

Stellar Spectra of Class R.—The second volume of the publications of the Detroit Observatory, which has recently been issued by Prof. Hussey, furnishes further evidence of the energy and thoroughness with which astrophysical investigations are carried on in America. The chief subjects dealt with are stellar spectra of type B containing emission lines, by R. H. Curtiss; observations of stars of class *Md*, by P. W. Merrill; the spectrum of ζ Ursæ Majoris, by L. Hadley; and the spectra of stars of class R, by W. C. Rufus. In each case a review of previous work is a valuable feature, and the volume is enriched by numerous beautiful reproductions of spectra. While all the contributions add considerably to previous knowledge, that on the stars of class R calls for special notice, as there has been much doubt as to the place of these stars in the stellar sequence. The peculiarity of class R spectra is that they include rays of shorter wave-length than is the case with the ordinary fourth type (N) stars. Ten of the sixty-six known members of the class have been studied in great detail, and six spectra of class N were also photographed for comparison. Mr. Rufus finds that the strength of carbon absorption is not a distinguishing feature between classes R and N, and that the real criterion for differentiating them is the intensity of the continuous absorption in the violet. The outcome of the discussion is to suggest that stars of class R form a connecting-link between the solar type and class N, and that the evolutionary sequence divides at the solar type, classes K and M forming one branch, and classes R and N constituting the other. The alternative possibility that classes M and K may belong to an ascending branch of the temperature curve, as would be the case in Lockyer's classification, does not appear to have been considered.

The radial velocities of the ten class R stars range from −49 to +25 km. per second, and give an average of 14·9 km. when corrected for the solar motion. The average colour-index is 1·7, as compared with 2·5 for class N.

BEN NEVIS AND GLEN COE.[1]

SHEET 53 of the map of Scotland comprises the especially interesting area around Ben Nevis, Glen Coe, and Loch Linnhe. This district includes the highest summit in the British Isles; it presents geological problems, both tectonic and petrologic, of unusual variety, and it has a most instructive and diversified physiography. It is described in a memoir which is a most valuable contribution to Scottish geology. This work has been mainly written by Mr. E. B. Bailey, and is characterised by its high literary quality, its originality of view, its happy expressions and apt comparisons, and its sympathetic summary of previous work on the district, beginning with Macknight and Macculloch at the beginning of the last century. The problems in the Ben Nevis district of most general interest are those connected with the physiography of the Scottish Highlands. The Highland glens have been often attributed to glacial erosion, and some of their most conspicuous features to the glacial deepening of the valleys. Mr. Bailey, however, submits ample evidence that the valleys were pre-glacial, that Glen Nevis, for example, has not been glacially deepened, that some of the gorges have escaped any serious glacial modification, and that the much-quoted hanging valleys of the district, being pre-glacial, cannot be due to the glacial enlargement of the main valleys.

Mr. Bailey adopts the view that the main north-west to south-east valleys are due to a pre-glacial river system, and that they were broken by cross valleys into segments separated by secondary watersheds. In the development of these river valleys he admits that earth movements played an important part, though he considers that the fractures which determined the valleys remained latent until opened by river action. He compares the valleys to the Zambezi gorge, which, though admittedly guided by fractures in the rocks, lacks the features indicative of the structural origin of these Highland valleys. Mr. Bailey attributes many of the valleys to erosion along shatter-belts, which were attributed by Dr. Marr, the author of the term, to the crushing of a band of rocks along an oscillatory fault that may produce no final displacement of the rocks beside it. The description of shatter-belts in the memoir (pp. 215–16) gives no clear evidence as to their origin. Some are bands of broken rock along ordinary faults; some are later than the last of the Cainozoic dykes, and are therefore geologically modern. So far as can be judged from the scanty evidence given in the memoir, these formations may be bands of rocks shattered between parallel ruptures due to tension during the elevation of the country into broad, low upfolds. Mr. Bailey remarks that if many of the Highland valleys had been originated along tension clefts some of them

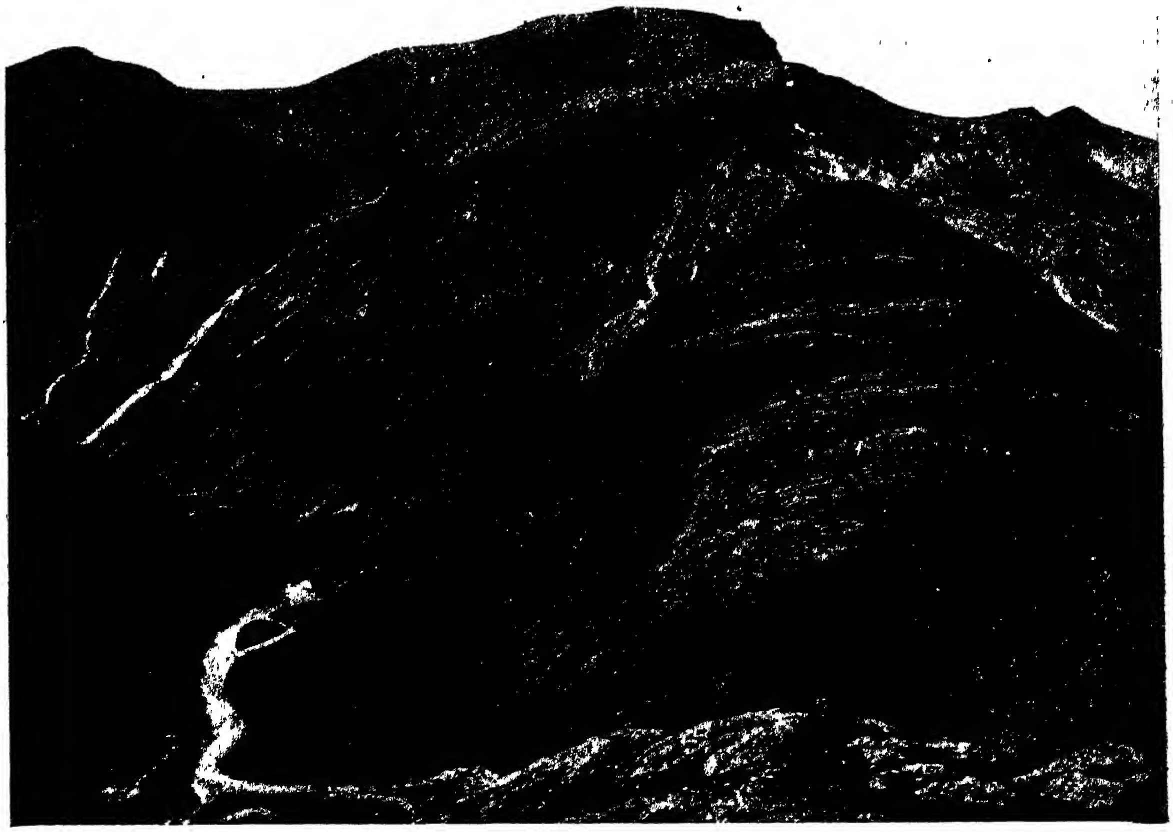

Fig. 1.—Ben Nevis and Glen Nevis Gorge. By permission of the Controller of H.M. Stationery Office.

[1] Memoir Geol. Surv. Scotland. "The Geology of Ben Nevis and Glen Coe, and the Surrounding Country." (Explanation of Sheet 53.) By E. B. Bailey and H. B. Mauffe. Pp. x+247+plates xi.

would be found filled by gravel; but this difficulty is inherent in all theories which assign the valleys a pre-glacial age. However the glens were formed, they must once have contained river gravels, and the fundamental difficulty in the pre-glacial history of Scotland is due to the removal of the earlier gravels during the glaciation. The author objects that by a mistake the view that the Central Valley of Scotland was a rift valley due to trough faulting has been attributed to him; but he stated so in the East Lothian memoir (1910, p. 10), referring to the time "when the Central Valley was originated as a structural feature directly influencing the scenery, a true rift valley, in fact, recalling that which at the present day includes the Great Lakes of Africa."

Within the area of this memoir are many interesting igneous rocks and structures, notably the cauldron of Glen Coe. The survey of the area by Mr. Bailey and his colleagues has shown that this formation

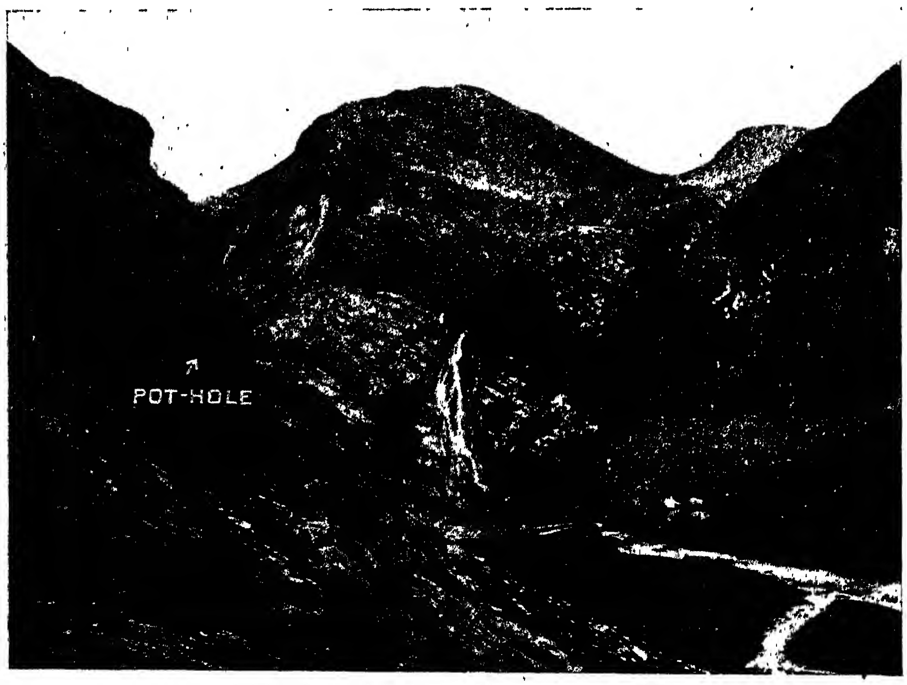

FIG. 2.—An Steall, the waterfall from a hanging valley, tributary to Glen Nevis. Water-worn crags on left due to stream tumbling down marginal crevasse. By permission of the Controller of H.M. Stationery Office.

was due to the subsidence of a block of ground along a circular fault, up which welled a ring of igneous rocks.

The memoir also contains an important contribution to the correlation of the Dalradian rocks of this area. Mr. Bailey explains the difficulties by assuming great recumbent overfolds. His colleague, Mr. Carruthers, on the other hand, adopts a simpler explanation based on a different classification of the rocks. Mr. Bailey recognises that Mr. Carruthers's interpretation is of equal standing with his own, which is advanced tentatively. It is difficult to judge the arguments without the map, the issue of which is delayed by the war. The discussion as to which of this series of schists is the oldest and which the youngest, and of their true succession, will probably be settled in areas further east, where the problem is simpler; as the rocks have been less disturbed by the complex earth movements and prolonged igneous activity to which the Ben Nevis district owes so much of its interest and beauty.

J. W. GREGORY.

THE GENETICS OF SILKWORMS.[1]

FEW animals lend themselves more readily to breeding work than the silkworm moth, and many valuable contributions to our knowledge of their genetics have been made by Japanese workers, among whom Dr. Tanaka has been one of the most successful. The present memoir deals with the inheritance of a number of characters. It is in part an amplification of data previously published by the same author, and in part a collection of new material. Tanaka has dealt for the most part with larval characters. He has worked out in detail the heredity of the patterns peculiar to the various races where his analysis has led him to the detection of seven Mendelian factors. Certain of these are inherited independently, but there are others forming one of those little groups about which there is at present such keen discussion in connection with multiple allelomorphs. In the present case there are four characters belonging to the group, viz. striped, moricaud, normal, and plain (or, in the absence of the P factor, striped quail, moricaud quail, quail, and pale quail). As in the other cases of similar nature, either the hypothesis of multiple allelomorphs or that of complete coupling covers the facts equally well.

One of the most interesting of Tanaka's earlier publications dealt with the peculiar relation existing between the factor for yellow cocoon and certain factors for larval pattern. In the present paper this relation has been worked out in great detail, and has involved the breeding of more than 100,000 individuals. Briefly, the results are as follows: The factor for yellow shows linkage with any one of the group of four characters mentioned above. In the female, linkage is complete, *e.g.* a female *ex* yellow striped×white normal forms yellow striped and white normal ova only, while a female *ex* white striped×yellow normal forms only white striped and yellow normal ova. In the male, however, the linkage is partial. The majority of the sperms are of the two parental types, but about one-quarter belong to the two other possible combinations. Thus a male *ex* moricaud yellow×striped white forms the four types of gamete, moricaud yellow, moricaud white, striped yellow, and striped white, nearly in the proportion 3:1:1:3.

In Drosophila, as is well known, a similar relation exists between sex and certain characters, but here it is always the male which shows complete, and the female partial, linkage. The significance of the parallel is brought out when it is remembered that in

[1] "Genetic Studies on the Silkworm." By Yoshimaro Tanaka. Journal of the College of Agriculture, Tohoku Imperial University, Sapporo, Japan, vol. vii., part 3, June, 1916. Pp. 129–256+plates i–vi.

Drosophila it is the male which is heterozygous for sex, while in moths it is the female.

The larval patterns investigated by Tanaka, though definite and distinct from one another, show in some instances much variation with respect to the intensity of their pigmentation. The normal and quail patterns can exist in several grades, so that a continuous series can be formed between the lightest and the darkest. Nevertheless, these grades are definitely transmitted, and Tanaka considers that his experiments afford good evidence that these apparently continuous series can be explained on the assumption of very few genetic factors.

An interesting section is that on the inheritance of moulting. In certain cases the three-moult behaves as a simple dominant to the four-moult character; in other cases the relation is more complex, though Tanaka considers that the facts can be explained by regarding the genetic difference here as one involving two factors. In any case, definite experiments show that the number of moults is much subject to environmental changes.

Records are given of a number of cases of mosaics and gynandromorphs, many of which are illustrated. In view of their importance for theories of sex-determination and fertilisation, it is to be regretted that no pedigrees are given.

Embodying as it does the greater part of our knowledge of the genetics of the silkworm, the memoir deserves careful study by the practical breeder, as well as by the professed geneticist, and we look forward to the publication of the author's analysis of cocoon characters which he promises upon some future occasion.

NEW DETERMINATIONS OF PROPER MOTIONS OF STARS.[1]

THE author of the catalogue before us is carrying out the suggestion of M. A. Donner that those observatories that finished their astrographic catalogue plates in good time should now repeat them, in order to determine proper motions. The Helsingfors plates were taken between 1892 and 1896; they were repeated, at similar hour-angles and calendar dates, between 1909 and 1913, giving an average time-interval of seventeen years.

The corresponding pairs of plates were examined simultaneously in the Blink apparatus, all cases of apparent shift being noted, and afterwards verified by measurement. A selection was made on each pair of eight faint stars that showed no shift; these stars were taken as the zero point to which the motions were referred. This method does not eliminate the small systematic effect due to the solar motion, or other common drift which the region may have. Correction was made for these effects by comparison with Boss, there being forty Boss stars in the region discussed (R.A. 9h. to 12h., N. dec. 39° to 47°). From these he adopts the corrections to his centennial motions, in R.A. −0·07s., in dec. 0″. There are eighteen additional stars in Porter's catalogues, which give centennial corrections −0·34s., +0·8″. Porter's proper motions do not claim to be reduced to an absolute system. A further comparison, not used by the author, is afforded by twenty-nine additional stars in the revised Groombridge catalogue. These give the centennial corrections to Helsingfors (small, but systematic) −0·15s., +1·1″. These tests show that the Helsingfors results are quite satisfactory, considering the shortness of the time-interval; they give us a useful list of 1016 proper motions, of which at least 900 are new. The following large motions of faint stars are noteworthy:—

R.A. 1900 h. m. s.	N. Dec. 1900 ° ′	Photo. Mag. m.	Centennial Motion ″	Pos. Angle. °
8 58 54	39 13	10·2	48	182
9 17 35	40 35	9·3	38	262
10 0 40	42 13	11·0	48	211
10 25 29	46 3	8·8	84	225
10 50 25	42 26	9·0	74	248
11 5 50	45 58	11·1	75	234
11 29 18	40 43	10·6	64	223
11 31 17	39 45	10·1	60	130

The author gives an examination of the mean parallaxes of stars of various magnitudes, and of the solar motion. The latter must be considered premature until the results for the whole zone are available. The mean parallaxes for magnitudes 3 to 7 are 0·032″; magnitudes 7 to 9, 0·021″; magnitudes 9 to 11, 0·017″. These are much larger than those of Kapteyn, which is explained by the fact that the present catalogue contains only those stars that show a sensible shift in seventeen years; these are comparatively near us.

ANDREW C. D. CROMMELIN.

[1] "Recherches sur les Mouvements Propres des Etoiles dans la zone photographique de Helsingfors." Par Ragnar Furuhjelm. (i) Clichés de 9h. à 12h. 4to, pp. 190. (Helsingfors: Imprimerie de la Société de Littérature Finnoise, 1916.)

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

CLASS IV. of the Estimates for Civil Services for the year ending March 31, 1918, dealing with Education, Science, and Art, has now been issued as a Parliamentary Paper. We record the main items of these estimates of expenditure, with details relating to scientific investigation and higher education.

It will be noticed, as has been pointed out already in these columns, that the grant in aid of scientific and industrial research has been increased to 1,038,050*l.*, an increase of 998,050*l.* on the grant for the year 1916–17.

United Kingdom and England.

BOARD OF EDUCATION.

	£
Administration	206,962
Inspection and examination	217,158
Grants in respect of public elementary schools, etc.	12,669,455
Grants for training of teachers	357,900
Grants towards expenditure on secondary schools and pupil teachers and bursars, etc.	962,600
Grants towards expenditure on other aided institutions, schools, and classes, and on assistance in choice of employment ...	613,960
Imperial College of Science and Technology and Chelsea Physic Garden (grants in aid)	33,650
Royal College of Art	7,743
The Victoria and Albert Museum	59,682
Science Museum	13,598
Geological Museum	3,171
Geological Survey of Great Britain ...	14,387
Bethnal Green Museum	2,249
Gross total	15,162,455
Deduct—	
Appropriations in aid[1]	2,675
Net total	15,159,780
Net decrease	26,952

[1] In addition, receipts from sale of catalogues and other publications supplied by the Stationery Office, estimated at 400*l.*, will be paid to the Vote or Stationery and Printing.

[The original estimate of 15,159,780*l.* for the Board of Education has since been increased to 19,015,780*l.* by a Supplementary Estimate of 3,856,000*l.*, made up as follows:—

Miscellaneous Inquiries, etc.

	£
Fees, travelling and other expenses in connection with the introduction of a scheme of pensions for secondary, technical, etc., teachers	2,500

Supplementary Grants to Local Education Authorities for Elementary Education.

These grants will be paid to local education authorities under regulations approved by the Treasury	3,420,000

Grants for Secondary Schools and Pupil Teachers and Bursars, etc.

Increased grants to secondary schools under regulations approved by the Treasury ...	433,500
Total	3,856,000]

British Museum.

	£
British Museum [2]	91,056
Natural History Museum	44,464
Gross total	135,520
Deduct—	
Appropriations in aid	6,925
Net total	128,595
Net decrease	4

Scientific Investigation,[3] etc.

	£
Royal Society—	
(i) (*a*) Scientific investigations undertaken with the sanction of a committee appointed for the purpose (4,000*l.*) and (*b*) scientific publications (1,000*l.*)	5,000
(ii) Magnetic Observatory at Eskdalemuir	1,000
(iii) National Physical Laboratory ...	7,000
(iv) Aeronautical Section of the National Physical Laboratory	18,275
Total for Royal Society ...	31,275
Meteorological Office	22,500
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	500
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Irish Academy of Music	300
Royal Zoological Society of Ireland ...	500
Royal Hibernian Academy	300
British School of Athens [4]	—
British School at Rome	500
Royal Scottish Geographical Society ...	200
National Library of Wales	4,200
National Museum of Wales	10,500
Solar Physics Observatory	3,000
School of Oriental Studies	4,000
North Sea Fisheries Investigation [4] ...	—

[2] The British Museum (Bloomsbury) (except the reading-room, etc.) and part of the Natural History Museum, South Kensington, are closed during the war.

[3] The expenditure out of these grants in aid, with the exception of that for the Meteorological Office, will not be accounted for to the Comptroller and Auditor-General, nor will any unexpended balances of the sums issued be surrendered by the payees at the close of the financial year. In the case of the Meteorological Office the expenditure, though not liable to surrender of balance, will be subject to audit by the Comptroller and Auditor-General.

[4] These grants are suspended owing to the war.

	£
Royal College of Surgeons in Ireland ...	2,000
Edinburgh Observatory	1,681
Imperial Transatlantic Expedition, 1914–15, Relief Expeditions	15,000
Total	100,006
Net decrease	1,665

Scientific and Industrial Research.

	£
Salaries, wages, and allowances	7,250
Travelling and incidental expenses	800
Grants for investigations carried out by learned and scientific societies, etc.[5] ...	24,000
Grants to students and other persons engaged in research [5]	6,000
Scientific and industrial research [6] (grant in aid)	1,000,000
Total	1,038,050
Net increase	998,050

Universities and Colleges.

Universities and Colleges, Great Britain.

	£
University of London	8,000
Victoria University of Manchester	2,000
University of Birmingham	2,000
University of Wales	4,000
University of Liverpool	2,000
Leeds University	2,000
Sheffield University	2,000
Bristol University	2,000
Durham University	2,000
Scottish Universities	84,000
Colleges, Great Britain	150,000
University Colleges, Wales	12,000
Welsh University and Colleges: Additional grant	20,500
Total for Universities and Colleges...	292,500

Intermediate Education, Wales.

	£
Examination and inspection, grant in aid...	1,200
Schools	27,500
Total for Intermediate Education, Wales	28,700
Grand total	321,200

Scotland.

Public Education.

	£
Administration	28,384
Inspection	43,044
Elementary schools	2,071,230
Continuation classes and secondary schools	228,500
Royal Scottish Museum, Edinburgh ...	9,849
Training of teachers	131,245
Examination of accounts	1,513
Total	2,513,765
Net decrease	30,977

[5] These grants will be distributed by a Committee of the Privy Council, on the recommendation of an Advisory Council, to promote the development of scientific and industrial research in the United Kingdom, and will be subject to such conditions as the committee may think necessary.

[6] This grant in aid will be paid to the account of the Imperial Trust for the Encouragement of Scientific and Industrial Research. The expenditure of the Trust will be audited by the Comptroller and Auditor-General, but any balance remaining on the account will not be surrendered at the close of the financial year. Grants will be made by the directions of a Committee of the Privy Council over an agreed period to approved trade associations for research, to supplement the funds of the associations, and payments in respect of such grants will not be liable to surrender by the grantees at the end of the financial year.

Ireland.

PUBLIC EDUCATION.

	£
Administration ...	32,167
Inspection ...	49,094
Training colleges ...	62,713
Model schools ...	3,891
National schools ...	1,591,580
Manual and practical instruction ...	12,415
Teachers' residences ...	6,700
Superannuation, etc., of teachers (grants in aid) ...	60,158
Gross total ...	1,818,718
Deduct— Appropriations in aid ...	700
Net total ...	1,818,018
Net decrease ...	173,566

INTERMEDIATE EDUCATION.

	£
Towards salaries of teachers, including cost of administration ...	40,000
Endowed Schools Commissioners ...	850
Total ...	40,850

SCIENCE AND ART.

	£
Institutions of science and art ...	47,950
Schools of science and art, etc. ...	103,550
Geological Survey ...	1,588
Examinations in courses of instruction conducted in technical schools ...	650
Gross total ...	153,738
Deduct— Appropriations in aid ...	1,520
Net total ...	152,218

UNIVERSITIES AND COLLEGES.

	£
Grants—	
Queen's University of Belfast ...	18,000
University College, Dublin ...	32,000
University College, Cork ...	20,000
University College, Galway ...	12,000
National University of Ireland and University College, Dublin ...	28,500
Additional grant to University College, Galway ...	2,000
Total ...	112,500

SUMMARY.

United Kingdom and England.

	£
Board of Education ...	15,159,780
British Museum ...	128,595
National Gallery ...	11,421
National Portrait Gallery ...	3,631
Wallace Collection ...	4,031
London Museum ...	2,300
Scientific Investigation, etc. ...	100,006
Department of Scientific and Industrial Research ...	1,038,050
Universities and Colleges, Great Britain, and Intermediate Education, Wales ...	321,200

Scotland.

	£
Public Education ...	2,513,765
National Galleries ...	3,980

Ireland.

	£
Public Education ...	1,818,018
Intermediate Education (Ireland) ...	40,000
Endowed Schools Commissioners ...	850
National Gallery ...	1,830
Science and Art ...	152,218
Universities and Colleges ...	112,500
Total ...	21,412,175
Net increase ...	764,787

[Supplementary Estimate for Board of Education, 3,856,000*l*.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The following degrees of doctors of science were conferred on April 24:—H. H. Green: Thesis, "Note on the Estimation of Potassium in Urine; Investigations into the Nitrogen Metabolism of Soil; The Sulphur Sheep Dips; Upon the Composition and Analysis of Polysulphide Solutions; Arsenical Dip-Tester; with other papers." T. M. MacRobert: Thesis, "Functions of a Complex Variable." W. R. Smellie: Thesis, "Contributions to the Geology of the West of Scotland: The Sandstones of the Upper Red Barren Measures to the East of Glasgow; The Cowal 'Landslip' of August 5, 1912; The Tertiary Composite Sill of South Bute; The Igneous Rocks of Bute." J. M'Lean Thompson: Thesis, "Studies in Floral Zygomorphy: I. The Initiation of Staminal Zygomorphy; The Anatomy and Affinity of '*Deparia Moorei*, Hook; The Anatomy and Affinity of *Platyzoma microphyllum*, R.Br."

IN an article on technical education in the *Electrician* for April 6 Mr. F. M. Denton outlines the proposals made by Viscount Haldane and by Sir Trevor Dawson for the improvement of education in this country, and makes some further suggestions. In general, he agrees with Lord Haldane that history, literature, language, and science should be taught to each boy, and that early specialisation should be discouraged. He points out that both Lord Haldane and Sir Trevor Dawson distinguish between what he calls the "applied humanities," which give a man knowledge of human nature and enable him to understand his neighbours, and the "useless humanities," the dead languages. With Lord Haldane he advocates the substitution of thought-stimulating work like the study of scientific phenomena for the mere memory exercise involved in the ordinary study of dead languages. Sir Trevor Dawson thinks the technical engineer should leave school at fourteen, enter a works as a half-timer, devoting the rest of the day to study at a technical school, and if he passes successfully through a five years' course should proceed to the university. Mr. Denton thinks half-time schemes inadequate, and stigmatises evening classes for boys who have put in a day at the works as "State sweating." He urges the State to undertake the education of each boy from fourteen to eighteen at a secondary school, and from eighteen to twenty-one at a technical school, as a good investment likely to advance the nation's welfare.

THE number of programmes of educational reform issued by associations competent to speak on the subject of our national education continues to increase, and fortunately an examination of the proposals made by them reveals a growing unanimity as to the essential changes which must be made in our system of education if national efficiency is to be secured.

One of the most recent of these programmes is that issued by the National Association of Head Teachers, which has a membership of nearly 6000. Among outstanding recommendations of the head teachers are the following: The age of exemption from full-time attendance should not be lower than fourteen; the leaving age should be raised to fifteen and then to sixteen, so soon as the necessary arrangements can be made; no class should exceed forty on the roll, and steps should be taken immediately to reduce them to that limit, and there should be a fully qualified teacher, trained and certificated, for each class. The head teachers urge that a committee of competent educationists should decide what subjects form a necessary and basic part of every curriculum, up to, say, twelve years of age, and the amount of time per week which should be devoted to them, and what subjects should be added in later years, attention being directed to the needs of particular localities. They insist, too, that the curriculum of every school should include an amount of practical work sufficient for the needs of the locality, and that a special room for such work should be attached to each school. They ask for a sufficient and suitable supply of secondary schools of varying type and character, and that every child with the requisite ability and inclination should be able to proceed to them. In large elementary schools where children remain beyond the age of fourteen, provision, the programme states, should be made for instruction in drawing, music, science, language, handicraft, and domestic economy. So far as continuation schools are concerned, the head teachers suggest that the employer of any person under eighteen should be required to enable him or her to attend day continuation classes for not less than eight hours a week, for which the employee should be paid the ordinary rate of wages, and that, in addition to this attendance at school, the hours of labour per week should not exceed forty-eight.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 29.—Sir J. J. Thomson, president, in the chair.—Sir William **Abney**: The fourth colourless sensation in the spectrum sensation curve when measured in the centre of the retina. At the end of the last century the author carried out a large series of observations on the luminosity of spectra of very low density, but only recently has he had an opportunity of working some of them out. Some time ago he published in the *Phil. Trans.* the three-colour sensations which apparently suffice to account for all the spectrum colours. There was a doubt if in the mixture of the sensations to form these colours some account ought not to be taken of the colour sensation which appears when a coloured ray is diminished in intensity for all colour to be absent and only a colourless residue is left. The author confines himself to the colours received on the centre of the retina, for on the periphery other conditions exist. The paper shows the method of observation which was employed, and, discussing the results, the author comes to the conclusion that the admixture of the colourless sensation with the three-colour sensations is so small as to be inappreciable, and that the sensation curves given in his paper, to which reference has been made, need no correction on this account.—G. W. **Walker**: Magnetic inertia. It is shown that a magnetised body may be expected to possess magnetic inertia just as an electrified body possesses electric inertia. In the case of a sphere of radius a and magnetic moment m the inertia for acceleration parallel to the magnetic axis is $2/5m^2a^{-3}C^{-2}$, and for acceleration perpendicular to the magnetic axis $4/5m^2a^{-3}C^{-2}$. (C is the velocity of radiation.) The order of magnitude of this inertia is considered in an astronomical as well as in an atomic connection.—F. **Tinker**: The selective properties of the copper-ferrocyanide membrane. In the present paper the selective properties of copper-ferrocyanide have been studied by measuring the change in solution concentration which takes place when the dry colloid is immersed in cane-sugar solutions of various strengths. It is found that the sugar solutions become stronger, owing to the fact that the water and not the sugar is taken up selectively by the ferrocyanide. The experimental results lead to the hypothesis that a colloidal hydrate, $Cu_2FeCy_6.3H_2O$, is first formed, and that this colloidal hydrate then takes up still more moisture by adsorption. The amount of adsorbed moisture taken up by the colloid decreases as the strength of the solution increases. It is also shown in the paper that the side of a membrane in contact with pure water has a greater moisture content than the side in contact with sugar solution. This fact supports the hypothesis—first advanced by Graham on experimental grounds—that osmosis across a membrane takes place because pure water induces a greater moisture pressure and concentration inside the membrane than the solution does.—C. M. **Williams**: X-ray analysis of the crystal-structure of rutile and cassiterite.—Dr. J. G. **Leathem**: Discontinuous fluid motion. The subject of the paper is the flow, with free stream-lines, of infinitely extended fluid past a finite obstacle with a sharp prow and curved sides. The methods of Levi-Civita, Cisotti, Villat, and Levy are compared with the writer's own method, and translated into formulations by curve-factors.

Zoological Society, April 3.—Prof. E. W. MacBride, vice-president, in the chair.—R. H. **Burne**: Notes on some of the viscera of an okapi (*Okapia johnstoni*, Lankester). The author described the anatomy of the soft parts of various portions of this animal.

Royal Meteorological Society, April 18.—Major H. G. Lyons, president, in the chair.—E. G. **Bilham**: The diurnal variation of atmospheric pressure at Benson, Oxon., during 1915. By means of hourly measurements of traces from the Dines float barograph at Benson Observatory, the mean diurnal inequalities for each calendar month of 1915, and for the year, have been obtained and submitted to Fourier analysis. With the exception of the amplitude of the 24-hourly oscillation, the mean results for the year are in good agreement with the normal values for Kew and Oxford. A discussion of the probable errors to which the results are liable leads to the conclusion that the first order term is the most susceptible to casual error due to non-periodic changes of pressure. It is, moreover, well known that this term is largely dependent on local meteorological and geographical conditions, so that considerable fluctuations are to be expected. Comparing the Benson results for individual months with the normal values for Kew, it is found that relatively high values of the diurnal range are associated with high values of the amplitude of the 24-hourly oscillation. The second and third order amplitudes show similar seasonal variations at the two stations.—Lieut. C. D. **Stewart**: Atmospheric electrical phenomena during rain. A preliminary investigation has been made into the values of the potential gradient occurring during rain. It is found that maximum values occur in summer and minimum values in winter. The maximum fine-weather values occur in winter. The form of the diurnal variation of rain potential gradient is still uncertain, although

it appears to have only one oscillation in twenty-four hours, as compared with the double oscillation in fine weather. In most cases rain depresses the potential gradient. Mean depressions have been compared with their corresponding mean hourly rainfalls. The depression was found to be a function of the rate of fall of rain. At Kew the potential gradient is measured directly in volts per metre by taking the potential in volts at the height of a metre. This method gives the time value as obtained from the surface density only where the electrical charge in the air is negligible. This is the case in fine weather, but probably not during rain. The possible errors have been calculated for different potential gradients; in the case of very fine rain the error may be some hundreds of volts per metre.

Paris.

Academy of Sciences, April 2.—M. d'Arsonval in the chair.—G. **Bigourdan**: The position and co-ordinates of the observatory of the Montmartre gate.—Ch. **Lallemand**: Time on board ship. It is pointed out that with the method at present in use for fixing true time at sea, it is possible that two vessels, coming from opposite directions, and noting at the moment of their meeting the time of the same phenomenon, may differ in their record by as much as 100 minutes, and it is impossible to deduce the true time. It is proposed by the Bureau des Longitudes that as soon as circumstances permit the true time shall be substituted, the time of the universal system of hour-zones, already in use on land in most civilised countries. From March 25 this plan has been adopted in the French Navy and on mobilised vessels.—M. Emile Picard was elected permanent secretary for the mathematical sciences in the place of the late G. Darboux.—J. **Renaud**: The influence of the Hermelles on the *régime* of the bay of Mont Saint Michel. An adverse criticism of the views recently published by MM. Galaine and Houlbert relating to the formation of the Hermelles reefs.—L. **Tribondeau** and J. **Dubreuil**: New microscopic stains derived from methylene-blue. Detailed descriptions are given for the preparation of methylene-violet and methylene-azure from methylene-blue. The preparation of three staining fluids from these colouring matters is also given.—Ph. **Glangeaud**: The peat bogs, the lakes, and the ancient glacial lakes of the Mont Doré volcanic massif.

Washington, D.C.

National Academy of Sciences (Proceedings, No. 2, vol. iii., February).—C. **Schuchert**: Atlantis and the permanency of the North Atlantic Ocean bottom. The Azores are volcanic islands and not the remnants of a continental mass. The tachylites dredged up from north of the Azores were probably formed where they now are. No known geologic data prove the existence of Plato's Atlantis in historic times.—G. H. **Parker**: The responses of hydroids to gravity. The geotropic response in Corymorpha is the result of activity of the neuromuscular sheath and not of the core cells.—E. P. **Allis**, jun.: The lips and the nasal apertures in the Gnathostome fishes, and their homologues in the higher vertebrates.—J. **Lipka**: Natural and isogonal families of curves on a surface.—G. H. **Hardy** and J. E. **Littlewood**: Some problems of Diophantine approximation: the series $e(\lambda_n)$ and the distribution of the points $(\lambda_n\alpha)$.—H. S. **Uhler**: Moseley's law for X-ray spectra. The law that the square root of the frequency of the lines is a linear function of the atomic numbers of the radiating elements is found to depart from the observed facts far more than the experimental errors, and an additional term is suggested which yields a formula agreeing with the facts. The order of magnitude of the high-frequency radiations of elements of small atomic number the spectra of which have not yet been obtained is discussed.—J. R. **Miner**: A note on the fitting of parabolas. Pearson's formula for fitting parabolas by the method of moments assumes the origin at the mid-point of the range. Similar formulæ are developed by the author when the origin is assumed one unit below the first ordinate, as in least squares.—F. G. **Pease** and H. **Shapley**: Axes of symmetry in globular clusters. The axis of symmetry of Messier 13 appears to be independent of magnitude, length of exposure, and distance from the centre. An elliptic distribution of stars is not confined to the Hercules cluster.—E. G. **Conklin**: The share of egg and sperm in heredity. The author discusses assumed equivalence of inheritance of both persons, egg differentiations which persist in embryo and adult, Mendelianism of inheritance through the egg cytoplasm.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of the island of Bawéan, Netherlands Indies. Six detailed analyses are given.—W. M. **Wheeler**: The phylogenetic development of subapterous and apterous castes in the Formicidæ. An array of facts bearing on the question of continuous variation *versus* mutation, with the conclusion in favour of the former.—C. **Barus**: Refractivity determined, irrespective of form, by displacement interferometry.—J. P. **Baumberger**: The food of *Drosophila melanogaster*, Meigen. The food of the larvæ is yeast; the insect depends upon these cells for its proteins. Adult flies do not need proteins, but survive much longer on sugar agar than upon yeast agar.—E. **Huntington**: Temperature optima for human energy. The optimum temperature appears to be very nearly 63° F., and largely independent of race or locality.—A. van **Maanen**: The parallax of the planetary nebula N.G.C. 7662. The value 0·023" is obtained, placing the nebula at a distance of 140 light-years with a linear diameter of nineteen times that of Neptune's orbit (see Nature, April 19, p. 153).—C. T. **Brues**: Adult hymenopterous parasites attached to the body of their host.

Victoria.

Royal Society, December 14, 1916.—Mr. J. A. Shephard in the chair.—F. **Chapman**: New or little-known Victorian fossils in the National Museum, part xx. Some Tertiary fish-teeth. The occurrence of the genus Carcharoides (*C. totuserratus*, Amegh., and *C. tenuidens*, Chapm.) affords an additional link in the evidence for the contemporaneity of the South American (Patagonian) and the Victorian (Janjukian) series. *Odontaspis elegans*, Ag. sp., *Myliobatis moorabbinensis*, Ch. and Pr., and *Sargus laticonus*, Davis, are now recorded from undoubted Janjukian (Miocene) beds, the latter being hitherto known only from the Oamaru beds of New Zealand. Rostral teeth of Pristis allied to the Mediterranean species, *P. antiquorum*, occur for the first time in the southern hemisphere, in the basal Kalimnan at Beaumaris. Pristiophorus (the side-gilled shark of Hobson's Bay), hitherto known only from the molasse of Würtemberg and the Upper Cretaceous of Mount Lebanon, is represented by a rostral tooth from the same beds, and the author shows Davis's *Lamna lanceolata* from the Oamaru series of New Zealand to belong to that genus, and conspecific with the Victorian form.—A. J. **Ewart**: Contributions to the flora of Australia, No. 25. The author notes the sudden appearance of aliens belonging to the genera Brachypodium and Orthocarpus. Other plants recorded as being established in Victoria are Ceratogyne, *Digitalis purpurea*, *Erica arborea*, and two species of plantain.—Elinor **Archer**: A disease or malformation of lucerne. The proliferation discovered in this plant was investigated

for traces of parasitic fungi and malformation caused by insects, but with negative results. The provisional inference is drawn that this malformation was caused more or less directly through malnutrition of the plant, which was growing in droughty country.—E. W. **Skeats**: The age of the alkali rocks of Port Cygnet and the D'Entrecasteaux Channel in the south-east of Tasmania. The previous evidence of the age of the alkali rocks of this district pointed to the Permo-Carboniferous or Trias, since they did not appear to intrude the diabase. Fresh evidence is now recorded which shows, at Kettering, that these rocks cut the diabase, and are therefore referred to a Cainozoic age.—A. D. **Hardy**: Teratological notes on Victorian plants. The author described a number of abnormal occurrences as affecting root, stem, branch, and fruit of indigenous flora, chiefly of the genus Eucalyptus. Fasciation in *Exocarpus gracilis* and spiral torsion in *Casuarina stricta* were noted.

BOOKS RECEIVED.

La Réforme Rationnelle de l'Heure. By E. Désortiaux. Pp. 14. (Paris: Gauthier-Villars.)

Seven Doubts of a Biologist. By S. A. McDowall. Pp. 64. (London: Longmans and Co.) 1s. net.

Transactions and Proceedings of the Royal Society of South Australia. Vol. xxxix. Pp. 892+70 plates +50 figures. (Adelaide: The Society.) 21s.

British Antarctic Expedition, 1907–9. Reports on the Scientific Investigations. Geology. Vol. ii., Contributions to the Palæontology and Petrology of South Victoria Land. By W. N. Benson and others. Pp. vii+269+38 plates+18 figures; also index to vols. i. and ii. (London: W. Heinemann.) 3 guineas net.

The Causation of Sex in Man. By E. R. Dawson. Second edition. Pp. xiv+226+illustrations. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net.

Bacon's New Series of Physical Wall Atlases. British Isles. (London: G. W. Bacon and Co., Ltd.) 26s.

DIARY OF SOCIETIES.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—Industrial Finance after the War: Prof. H. S. Foxwell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—High-tension Overhead Transmission Lines: G. V. Twiss.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A New Series of Economic Maps: G. Philip.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 5.30.—The Organs of Hearing in relation to the War: Dr. Dundas Grant.

SATURDAY, APRIL 28.

ROYAL INSTITUTION, at 3.—Principles of Aerial Navigation: Prof. G. H. Bryan.

PHYSICAL SOCIETY, at 5.—Note on the General Equation for Wave Motion in an Elastic Medium: Prof. J. A. Fleming.—The Effect of Stretching on the Thermal Conductivity of Wires: A. Johnstone.—Cohesion: Prof. H. Chatley.

MONDAY, APRIL 30.

ROYAL SOCIETY OF ARTS, at 4.30.—The National Shortage of Iron Ore Supplies. I.: Available Home Supplies of Iron Ore: Prof. W. G. Fearnsides.

TUESDAY, MAY 1.

ROYAL INSTITUTION, at 3.—Tetanus: Prof. C. S. Sherrington.

FARADAY SOCIETY, at 8.—*Discussion*: Osmotic Pressure: Opener: Prof. A. W. Porter.—Papers: The Colloidal Membrane: Its Properties and its Function in the Osmotic System: Dr. F. Tinker.—Osmotic Pressure in Relation to the Constitution of Water and the Hydrates of the Solute: W. R. Bousfield.

RÖNTGEN SOCIETY, at 8.15.

ZOOLOGICAL SOCIETY, at 5.30.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Some Human and Animal Bones, Flint Implements, etc., discovered in Two Ancient Occupation-levels in a Small Valley near Ipswich: J. Reid Moir.

WEDNESDAY, MAY 2.

GEOLOGICAL SOCIETY, at 5.30.—Supplementary Notes on Aclisina, De Koninck, and Aclisoides, Donald, with Descriptions of New Species: J. Longstaff.—The Microscopic Material of the Bunter Pebble Beds of Nottinghamshire, and its probable Source of Origin: T. H. Burton.

ROYAL SOCIETY OF ARTS, at 4.30.—Herb-growing in the British Empire: Its Past, Present, and Future: J. C. Shenstone.

ENTOMOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—James Forrest Lecture: The Standardisation of Engineering Materials, and its Influence on the Prosperity of the Country: Sir J. Wolfe Barry, K.C.B.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Phenacetin and Allied Compounds by means of Hypochlorous Acid: A. D. Powell.—A Rapid Method for the Determination of Nickel and Cobalt in Ores and Alloys: Dr. W. R. Schoeller and A. R. Powell.—Note on Opium Poisoning Cases: J. Webster.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Excitation Wave in the Heart: Dr. Thomas Lewis.

ROYAL INSTITUTION, at 3.—Pagan Religion at the Time of Coming of Christianity: Prof. Gilbert Murray.

MATHEMATICAL SOCIETY at 5.30.

IRON AND STEEL INSTITUTE, at 10.30 a.m.—Steel Ingot Defects: J. N. Kilby.—Influence of Surface Tension on the Properties of Metals, especially of Iron and Steel: F. C. Thompson.

INSTITUTE OF METALS, at 8.30.—Seventh May Lecture: Researches made Possible by the Autographic Load-Extension Optical Indicator: Prof. W. E. Dalby.

FRIDAY, MAY 4.

ROYAL INSTITUTION, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

IRON AND STEEL INSTITUTE, at 10 a.m.—The Penetration of the Hardening Effect in Chromium and Copper Steels: L. Grenet.—Cementation by Gas under Pressure: F. C. Langenberg.—Origin and Development of the Railway Rail: G. P. Raidabaugh.—Case Hardening of Iron by Boron: N. Tschischewsky.—Determination of the Line S.E. in the Iron-Carbon Diagram by Etching Sections at High Temperatures *in vacuo*: N. Tschischewsky and N. Schulgin.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Correlation of the Ingletonian Slates: J. F. N. Green.—The Landslips of Folkestone Warren and the Thickness of the Lower Chalk and Gault near Dover: C. W. Osman.

SATURDAY, MAY 5.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

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THURSDAY, MAY 3, 1917.

THE PROBLEM OF HEREDITY.

A Critique of the Theory of Evolution. By Prof. T. H. Morgan. Pp. x+197. (Princeton: University Press; London: Oxford University Press, 1916.) Price 6s. net.

THE title of this little volume of four lectures delivered at Princeton University is likely to cause some disappointment. The book is almost entirely an exposition of certain facts as to inheritance ascertained by experiments with the fruit-fly, *Drosophila ampelophila,* and "a review of a long series of researches as to the nature of the hereditary material." The author claims that "the mechanism of heredity has been discovered" and that "the problem of heredity has been solved." He holds that "the mechanism of the chromosomes offers a satisfactory solution of the traditional problem of heredity."

Whilst all credit is due to Prof. Morgan for his long and careful investigations—which have been published elsewhere and are here summarised with excellent diagrams—it cannot be admitted that the demonstration of the numerical relations of the chromosomes distributing to the germ-cells the hereditary factors carried by the parents is of the importance which he supposes. The "traditional problem of heredity" cannot be correctly described as limited to the inquiry as to what are the carriers of the factors of heredity and their relations to one another as carriers. The questions as to *how* the factors arise and *how* they influence the development of the embryo cannot, as Prof. Morgan somewhat arbitrarily states (in so many words), be excluded from a solution of the real, traditional, and actual problem of heredity. The fact seems to be that the knowledge of what is called "Mendelian inheritance" and the relation to it of the chromosome mechanism does not take us much further into the "problem of heredity" than we had already got when, after Darwin had stated the facts known to him and the views they suggested in his "Animals and Plants under Domestication," Edouard Van Beneden and other histologists first unravelled the chromosomes and gave us the classical records of their visible activity in fertilisation.

We have not got much further since those days, but there is no doubt that some facts of interest have been added to the stock of knowledge by those who have confirmed Mendel's experiments. When we look to the present summary for some statement of what important progress in our conception and understanding of inheritance is to be reported, we are reluctantly driven to the conclusion that what Prof. Morgan calls "a satisfactory solution of the traditional problem of heredity" is only a restatement of the problem in terms of invisible "factors" associated with the chromosomes. The existence of such "factors" is not a new inference, but has been a feature of theories of inheritance both before and since Darwin's treatment of the subject. Mendel contributed to knowledge the solid fact that in certain easily observed cases (if not universally) a pair of opposed or contrasted factors—present one in one parent and one in the other—do not really "blend" in cross-breeding, but in successive in-bred generations of the hybrid offspring (of intermediate or mixed character) become separated out in two pure races, each identical, so far as the factor selected for study is concerned, with one of the original cross-bred parents. That observation and its extensive confirmation are important steps in the study of the nature, origin, and possibilities of the "factors." So also is the demonstration of their close association with the chromosomes, which was suggested as soon as the activity of those structures in the process of fertilisation was first observed.

This is, however, only a beginning: it remains to be seen how far the application of these results to the actual facts of inheritance as stated by Darwin in the successive chapters of his "Variation of Animals and Plants under Domestication" helps us to explain or understand those facts. So far the application has not been made—so as to obtain any result beyond a re-statement of the facts in other terms and language—nor does there appear to be any immediate prospect of progress in that direction.

An important suggestion is made by Prof. Morgan, namely, that the "factors" themselves may vary or fluctuate. He says: "I do not know of any *a priori* reason why a factor may not fluctuate, unless it is, as I like to think, a chemical molecule." He, however, proceeds to give evidence opposed to such fluctuation.

It seems that the line of investigation pursued by Prof. Morgan and other recent experimenters who have developed Mendel's original observations into an imposing volume of detail has disappointed expectation. It will, we believe, be of service, but it has, to the regret of all, not led into the fruitful region anticipated by those who entered upon it with so much enthusiasm and energy. In order to gain a deeper understanding of the many remarkable facts of organic heredity a new departure is necessary, new inductions suggesting new and untried lines of observation and experiment.

So far as the title of these lectures, "A Critique of the Theory of Evolution," is concerned, there is very little said in them which justifies it. Prof. Morgan objects to the use of the word "evolution" as employed by Herbert Spencer, on the ground that it is "rather an empty generalisation to say that any kind of change is a process of evolution. . . . What has," he asks, "the evolution of the stars, of the horse, and of human inventions in common?" This seems to be somewhat unnecessary, since no one has said that "*any* and *every* kind of change is a process of evolution," and the instances of evolution which he cites have, as such, well-recognised features in common. Attempts to correct flagrant misuse

of words are often of great value; but a writer may bring his own qualities of judgment and understanding into discredit by erroneously supposing that a misuse requires correction where no such misuse exists.

We are also unable to admit the validity of Prof. Morgan's assimilation of the "artificiality" of the conditions under which humanly selected breeds are produced and studied to the "artificiality" of a spectroscope or a galvanometer (p. 84). The justification for reserve and caution in generalising in the former case is not that these breeds are "artificial," but that the essential and significant conditions of the phenomena they present are not clearly ascertained, whilst in regard to the instruments known as spectroscope and galvanometer those conditions are accurately established.

The point of greatest interest at the present moment in a critique of the theory of organic evolution by a capable and accomplished investigator of the facts of inheritance—such as Prof. Morgan—is his answer to the question: "Does natural selection influence the course of evolution?" (p. 187). Prof. Morgan gives a very carefully worded answer in the affirmative. He says: "If through a mutation a character appears that has a *beneficial* influence on the individual, the chance that the individual will survive is increased, not only for itself, but for all of its descendants that come to inherit this character. It is this increase in the number of individuals possessing a particular character that might have an influence on the course of evolution." He goes on to say: "The causes of the mutations that give rise to new characters we do not know, although we have no reason for supposing that they are due to other than natural processes. Evolution has taken place by the incorporation into the race of those mutations that are beneficial to the life and reproduction of the organism. Natural selection as here defined means both the increase in the number of individuals that results after a beneficial mutation has occurred (owing to the ability of living matter to propagate), and also that this preponderance of certain kinds of individuals in a population makes some further results more probable than others. More than this natural selection cannot mean, if characters are fixed and are not changed by selection."

We do not know of anyone who maintains that factors are changed by selection. Darwin certainly did not make such a misuse of the word "selection." But there is a great field of inquiry still to be undertaken which is indicated by the words "if factors are fixed." We are a long way from possessing knowledge that would justify the conclusion that they *are* fixed—as Prof. Morgan is careful to point out (p. 166). Darwin held that they are subject to influences which cause them to vary, and it is by research in this area that we may hope for future advance in the understanding of the complex web of the phenomena of heredity.

E. RAY LANKESTER.

GENERALISED CO-ORDINATES.

An Introduction to the Use of Generalised Co-ordinates in Mechanics and Physics. By Prof. W. E. Byerly. Pp. vii+118. (Chicago and London: Ginn and Co., 1916.) Price 5*s*. 6*d*.

THIS work is sure to be welcomed, because Prof. Byerly has undoubtedly the gift of appealing successfully to the average student. More than that: in its small compass it includes a wide scope because, starting with the notion of generalised co-ordinates in its abstract analytical form, it proceeds to the discussion of such things as the Hamiltonian equations, the principle of least action, the ignoration of co-ordinates, and the proper use of the modified kinetic-energy function. For a teacher the book is cheap, if only for the example (*d*) on p. 21, and the subsequent discussion of the same example on pp. 98–103. We have not seen a more illuminating example within the range of an ordinary student; it shows admirably the difference between abstract dynamics, where all necessary data are provided, and practical physics, where the data are experimental, and need by no means correspond with the actual elements of the problem. In this case it is a question of guessing at the simplest explanation of an unseen "control" of a mechanism on which we can make experiments within a certain range.

Among the many merits of this book we may signalise the following: the examples are almost all instructive and free from artificiality; we have some where the same result is obtained by different advanced methods—for instance, pure Lagrange, pure Hamilton, and Hamilton *plus* Routh (with a modified function), and these are compared with previous solutions by elementary methods. As a matter of notation, we may direct attention to the symbol $M_{q,r}$ for the energy-function modified with respect to the position-co-ordinates q, r. The meaning of partial derivatives is so variable in this connection that we should like such symbols as $T(q^2)$, $T(p^2)$, $T(pq)$ introduced throughout for the velocity-forms, momentum-forms, and "mixed" forms of T whenever there is any risk of confusion. The fact that, *in a certain sense*, the Lagrangian function L means $T-V$ (strictly $T(q^2)-V$), and the Hamiltonian function means $T+V$ (strictly $T(p^2)+V$), is extremely baffling to a beginner. In particular, the "canonical" equations of Hamilton imply a special representation of the energy-function.

Prof. Byerly's book is so good that it deserves a much more searching criticism than the present reviewer can pretend to give; but a few remarks may be ventured here. The example (p. 18) about the dog running down a plank is all right as it stands, but it tacitly implies that the dog is reduced to a mere machine applying a constant frictional force to the plank parallel to the inclined plane. Students who try to solve "animal" problems by Lagrange's method may make some fearful howlers. Another point (p. 72) is the question how far we can treat ω_1, ω_2, ω_3 occurring

in T as if they were ω_x, ω_y, ω_z referred to fixed axes; here Prof. Byerly is not so clear as Routh, and although he makes no mistake (the chapter is on impulsive forces), he may mislead his reader unwittingly. As a mere matter of typography we may note that $\dot{\phi}^2 \cos\theta$ is much clearer than $\cos\theta\dot{\phi}^2$ (and so in many other cases). In the answer (p. 9) on the simple pendulum (ex. 2) it would be well to reduce R to a configuration expression ($R = (3\cos\theta - 2\cos\alpha)mg$); on p. 18 read "*mg* the weight of the dog"; and there may be other trivial blemishes of the same sort.

It may be added that there are proofs of Thomson's and Bertrand's theorems in the proper dualistic form, examples taken from hydrodynamics and electrodynamics, and two appendices—one on dynamical formulæ, the other on the calculus of variations. We hope that Prof. Byerly's book will have the full success which it deserves.

G. B. M.

TROPICAL AGRICULTURE.

Tropical Agriculture. By Dr. E. V. Wilcox. Pp. xviii+373. (New York and London: D. Appleton and Co., 1916.) Price 10*s*. 6*d*. net.

THE selection of a title is sometimes not an easy matter. "Tropical Agriculture" has been given as the name of the book before us, written by Dr. E. V. Wilcox, of the States Relations Service of the U.S. Department of Agriculture. The book deals very briefly with nearly every product of the tropics, whether agricultural or otherwise. In this case the title is, therefore, misleading. But in the preface the author speaks of "tropical products," and one wonders why he did not give his book that name. It would have been fully descriptive and appropriate.

The author tells us that his book was "written from the standpoint of the general reader, business man, and agricultural student." But in the next breath the agricultural student is dismissed and the book is then said to deal with tropical agriculture in the commercial sense. Moreover, Dr. Wilcox regards the literature of his subject as abounding in exaggeration—rather hard on the authors of the numerous publications enumerated by him in the appendix. Still, it is satisfactory to be assured that our author, knowing the shortcomings of his predecessors, will not likely err in overdrawing his pictures of the wonders and resources of the tropics.

The opening chapters on tropical climate, soils, agricultural methods, etc., might with great advantage be carefully revised and reconsidered. The assumption, for example, that the inhabitants of tropical countries were ignorant of agriculture until the "white race" invaded their country is very nearly an entire misconception. It is certainly not true of India, China, and Japan. The systems and methods these peoples are now following came down to them through countless ages. It is quite uncalled for and, moreover, irrelevant to say that "the native races are obviously inferior to the white race, and that their supposed rights to property in tropical countries must yield to the superior demands of the white race." It would be more correct to affirm that the closer we study native conceptions and practices—the evolutions of centuries towards environment—the more readily and completely shall we attain to the higher flights of tropical industry.

So much for the speculations of our author. Turning over the pages of his book cursorily, the reader is disappointed to note a lack of proportion, an utter disregard of uniformity in treatment, and an entire absence of method—qualities essential in a book of reference. The plates serve a pictorial rather than a practical purpose. Facing p. 144, for example, a hand is seen to thrust the rhizome of an aroid into view. Below the illustration has been printed "Dasheen Tuber, Trinidad Variety." There is no number to the plate (nor, in fact, to any plate), so that the reader has to turn to the index to find the text—some eleven pages farther on. But in the text no reference is made to the plate, so that, after perusing the book through, the reader may remain ignorant that the "dasheen" has been illustrated.

The book has twenty-one chapters, as well as an appendix and an index. Turning to chap. xii., which deals with fibres, it is found that two pages have been devoted to cotton, three-fourths of a page to jute, four pages to sisal, and so on—no attempt at proportional spacing to importance of subject. But in the twenty-one lines given to jute the writer manages to inculcate three egregious errors. He speaks of the flowers being "rather conspicuous," which they most certainly are not, gives the Indian area of the crop at half what it is, and speaks of a yield at very nearly four times the record production of the crop. On p. 70 it is observed that tea has been cultivated in India since 1875, whereas it was extensively grown in that country thirty to forty years before that date. A photograph of Japanese hedges of the tea plant is given, apparently as being illustrative of the great tea cultivation from which the supplies of commerce are drawn. Nothing could be less accurate. The geography of our author is often startling, as, for example (p. 141): "Large quantities of pistachio-nuts are shipped from Afghanistan to India."

The book, as it stands, cannot become a text-book for either the merchant or the student. It needs drastic revision.

OUR BOOKSHELF.

Science and Education: Lectures delivered at the Royal Institution of Great Britain. Edited, with an Introduction, by Sir E. Ray Lankester. Pp. 200. (London: W. Heinemann, 1917.) Price 1*s*. net.

THESE lectures were given at the Royal Institution in 1854, and the lecturers were Whewell, the famous Master of Trinity College, Cambridge, Faraday, Latham, the philologist, Daubeny, then professor of chemistry and botany at Oxford, Tyndall, James Paget, the eminent surgeon and

pathologist, and W. B. Hodgson, who became professor of political economy in Edinburgh University. They should be read by everyone interested in education, and this convenient little volume at the cost of one shilling will enable them to do so.

Sixty-three years have elapsed since these stimulating and powerful discourses were delivered, and some of the illustrative references to the scientific views as well as to the popular superstitions current at that time require explanation or modification. This is provided by a series of useful notes inserted by the editor after each lecture.

The lectures are not occupied with denunciations of the "elegant imbecility of classical learning," but with an exposition from various points of view of the advantages to education of the observation of natural phenomena and the scientific study of language. In 1854 there were not more than two or three schools in England where natural science was taught, and in the universities such subjects were almost ignored except where they formed an integral, though subordinate, part of the medical curriculum. We have moved on since that time. All the large schools and some of the small are provided with laboratories and teachers more or less competent. The time given to experiment and observation is, however, quite insufficient, and until headmasters with purely literary qualifications and sympathies are got rid of progress will still be slow.

Some Questions of Phonetic Theory. By Dr. Wilfrid Perrett. Pp. vi+110. (University of London Press, 1916.) Price 2*s.* 6*d.*

THIS book forms a notable contribution to the literature on the science of speech. The first chapter exposes some current misconceptions as to the position of rest of the organs of speech. In the remaining three chapters (entitled "Willis on Vowel Sounds," "The Wheatstone Test," and "The Compass of the Mouth") Dr. Perrett deals with the intricate subject of vowel-pitches. He gives examples of the hopelessly divergent results which have been arrived at by different authorities on acoustics, and endeavours, in our opinion with success, to bring some order into the chaos. Naturally the work of those who have contributed to bring about the chaos comes in for strong criticism. Upon Helmholtz Dr. Perrett is particularly severe; he shows that "wherever it bears upon phonetics Helmholtz's book has no right to be considered authoritative," and states that even in other branches of the theory of sound Helmholtz attained a reputation to which the quality of his work did not entitle him. The Helmholtzian harmonic overtone theory of vowel-quality is shown to be untenable by simple experiments described on pp. 79, 81, and 107—experiments which may be performed without difficulty by any phonetically trained person.

The methods by which Dr. Perrett arrives at his interesting table of vowel-pitches (p. 98) appear to us to be sound.

We commend the work to the notice not only of those interested in the science of speech, but also of students of sound generally. D. J.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Science Teaching and National Character.

I WAS asked to address a Workers' Educational Association meeting; was prevented by illness; and wrote a long letter to the chairman. Phrases from this letter, referring to the teaching of science, very much abbreviated, appeared in the newspapers. Now NATURE (April 19) flagellates me for what I am supposed to have said. And, indeed, if I had meant anything so grotesque as you naturally inferred from the disconnected phrases you saw, I should have deserved all your strictures

What I *did* say, briefly, was that we had seriously neglected science, not so much in schools as in higher work and in practical life; that we were realising this; but that there was a danger of our trying to mend matters in the wrong way, by cramming too much science into the schools, where, certainly up to the age of sixteen, the boy would profit most from an education in the "humanities," even if he intended to devote himself to science later. By the "humanities" I meant the studies which deal with the thoughts and actions of man. I added that there was another danger, quite distinct in character, attaching to our new-found reverence for physical science, and this was that we might be tempted to imagine that we could apply its concepts and methods to the totally different problems presented by human life. I do not remember whether on this occasion I used an illustration which I have used at other times: that of the older political economy, which, in trying to become an exact science setting forth unalterable laws, had lost touch with the realities of social life. But I *did* give an illustration from Germany, where, I urged, the attempt to apply the Darwinian theory (misinterpreted) to the life of that strange justice-loving animal, man, had produced the hideous political philosophy of Treitschke and modern Germany, and had largely contributed to bring about the war. I did not say, or mean, or think anything so absurd as that science caused the war, or that Germany's soul had been poisoned because she took science more seriously than we. But it is possible that some of my phrases, hurriedly written from a sick bed, may have conveyed that impression. If so, I am glad that you have directed attention to them. RAMSAY MUIR.

Manchester, April 23.

WE are glad to know that the published extracts from Prof. Ramsay Muir's letter do not represent his views as to the influence of science upon national character. Prof. Muir need not fear, however, that too much attention will be given to science teaching in schools, or that British men of science are likely to leave the working of the human spirit out of consideration because this has been done by German historians and philosophers. All that the most advanced reformers of school curricula ask is that the natural sciences (with geography) shall be given approximately the same amount of school time as three other main groups, namely, languages and literature, English and history, mathematics and other subjects, and that up to the age of about sixteen years all these subjects should be fairly represented as essential parts of a general educational course.

There is no intention of "cramming too much science into the schools," but a strong case can be made out against the present cramming of classics, whether considered as a means of mental development or a preparation for life. The assumption that science is a special study, to be taken up after the age of sixteen or so, while what are called the "humanities," but are chiefly dead languages and literature, are not specialised, is a fallacy which advocates of literary learning persist in believing, though it has been exposed over and over again.

It is possible that a perverted view of Darwinism has been put forward in Germany in justification of the doctrine of "frightfulness," but naturalists as a body must not be held responsible for this conception, which was, indeed, repudiated completely by Huxley in his "Evolution and Ethics." The ancient and modern histories studied in schools and colleges are mainly concerned with wars and dynasties, and it is to these "humanities" rather than to science that we must look for the origin of the German mental condition and the conduct of the present conflict.—ED., NATURE.

The Frequency of Snow in London.

I THINK the number of days with snow in the early months of 1917, as quoted in Mr. Harding's article in NATURE of April 19 according to the records of an observer at Wandsworth Common, is too low for the metropolitan district generally, inasmuch as I have recorded snowfall, chiefly at Hampstead, but partly also at Kensington, on no fewer than forty-seven days during the past winter, distributed as follows: November, 1; December, 3; January, 20; February, 4; March, 11; April, 8; out of which forty-three belong to 1917—a figure nine in excess of that quoted by Mr. Harding. I do not think the discrepancy is due to Hampstead's height some three or four hundred feet above the more central parts of London, inasmuch as a difference of altitude of this small order tells more effectively upon the length of time snow lies on the ground than on its frequency of falling; but I suggest it may arise from the omission of days of very slight snowfall, of days with sleet, or, possibly, even from a failure to recognise uncommon varieties of snow.

An interesting case of an unusual variety of snow, which I heard superficial observers calling "sleet," in spite of the fact that the precipitation was entirely free from liquid drops, occurred during the week-end of January 20–21, when there fell in London a continuous frozen drizzle composed of fine crystalline particles, gradually whitening roofs and open spaces with a thin layer having the appearance of ordinary snow. Now, if the physical criterion of rain is the spherical drop of water, of hail the stone, pellet, or granule of compact ice, and of snow the individually formed crystal of ice, whether it falls alone, or stuck together with others in large flakes, or broken up by wind into powdery fragments, it is clear that the precipitation of January 20–21 had the essential character of snow, and was not a transition form between snow and rain or between snow and hail.

L. C. W. BONACINA.

30 Parliament Hill, Hampstead, N.W.3., April 28.

Scarcity of Wasps in Kashmir in 1916.

READING the correspondence in NATURE on the scarcity of wasps in England, and the interesting article by Prof. Carpenter (NATURE, January 25), suggested to me that it might be worth while to record my experience in Srinagar, Kashmir, during the years 1915 and 1916, because of the curious analogy.

During the autumn of 1915 two species of wasp were observed, one of these somewhat resembling *Vespa vulgaris*, and the other larger and more like a hornet. These were both excessively abundant in and around the house I occupied. The large suspended nests of both species, covered with active workers, were in almost every bush and shrub near the house and attached to the walls of the house, and it was only by repeated efforts that we could prevent the insects starting new colonies on the ceilings of the rooms in the house.

The abnormally dry season in Kashmir beginning in May, 1915, may have been specially favourable for the development of these wasps, but if so it is not easy to account for their subsequent scarcity. As in England, the year 1916 was remarkable for the rareness of wasps. The winter was mild and dry, and the shortage of rain persisted through the spring. Scarcely a single wasp of the smaller species was seen during the summer and autumn following. The only nests of the larger kind I saw were two very small ones suspended from the woodwork of the spectroheliograph, where I could daily watch the process of construction. This, however, was a most tedious operation, for after several months the nests were no larger than 1½ in. or 2 in. in diameter—that is, about a quarter the size attained in 1915—and instead of swarms of active workers, only one or two rather sluggish insects were seen on the nests.

The apparent despondency of the wasps in 1916 was in strong contrast with their energy during the previous season. Yet, so far as human beings could judge, the two seasons were equally inspiring as regards clear blue skies and brilliant sun.

Is it a mere coincidence that wasps of different species were one year abundant, the next year scarce, in such widely distant localities as England and Kashmir?

J. EVERSHED.

The Observatory, Kodaikanal, South India, March 14.

Ceratonia Siliqua and the Carat Weight.

IT is usually stated that the carat weight of jewellers and diamond merchants is derived from the hard seeds of the locust tree, *Ceratonia siliqua*, which were anciently used as weights. Having had occasion to obtain some of the beans, I weighed several of the seeds to see what sort of error would be incurred if they were used as weights. Out of forty-four seeds, four were shrivelled and obviously abnormal, weighing from 0·037 to 0·064 grm. each; the remaining forty seeds varied from 0·120 to 0·268 grm. The average weight of a seed was 0·2004 grm., with a probable variation of ±0·0235. The median was 0·207, and the modal average 0·204. The variations were not well distributed. The old diamond carat, of which 151½ made 1 oz. troy, would weigh 0·205 grm.; the decimal carat now in use is 0·200 grm. It would appear, therefore, that the carat weight could be recovered with some approach to accuracy by weighing a number of seeds of the locust bean. It is also evident that the use of such seeds as weights must have given opportunities for fraudulent dealing in the precious commodities gauged by means of them, since deviations of from 30 to 40 per cent. from the average may occur. The variations in weight due to varying humidity of the air are not great; twenty-five seeds exposed to the air of a room for twenty-three hours in rainy weather gained 0·06 per cent. in weight, and after thirty-six hours over sulphuric acid lost 1·71 per cent. in weight.

J. H. COSTE.

Utopia, Teddington, April 23.

THE BRITISH SCIENCE GUILD.

THE eleventh annual meeting of the British Science Guild was held at the Mansion House on Monday, April 30, when the Lord Mayor presided. After the meeting had been welcomed by the Lord Mayor, Sir William Mather, president of the Guild, opened the proceedings, alluding briefly to the part taken by the British Science Guild in the encouragement of applied science during his tenure of office. He explained also the proposal of the committee of the Ramsay Memorial Fund to raise 100,000*l.* with the view of founding a chemical laboratory and a series of fellowships in memory of Sir William Ramsay at University College, London. In conclusion, Sir William Mather announced his retirement and the nomination of Lord Sydenham to succeed him as president of the Guild.

The election of Lord Sydenham as president, of the Lord Mayor as a new vice-president, and of the executive committee was moved by Sir Boverton Redwood and seconded by Prof. R. A. Gregory. The motion, which was carried unanimously, also included the adoption of the annual report. Sir Boverton Redwood referred to the valued services of Sir William Mather during his four years of office, and both speakers directed attention to the exceptional progress in the organisation of science during the past year. Prof. Gregory referred to the great step forward represented by the establishment of the Department of Scientific and Industrial Research, and pointed out that this action had led to similar developments in Australia, Canada, and the United States. In fact, many of the aims for which the Guild had been working were now in course of realisation.

The annual report contained a summary of the chief scientific and technical committees which are working in connection with various Government Departments, and a note on the report recently issued by the Board of Scientific Societies on "National Instruction in Technical Optics." An account was also given of the proceedings of the Metric System Committee, which is engaged in preparing two draft Bills such as would pave the way for the introduction of a metric system of weights and measures. Two appendices dealing with the work of the Canadian and South Australian branches of the Guild contain interesting accounts of the steps being taken in these countries for the encouragement of applied science. Under the title "The Promotion of Scientific and Industrial Research" the report also contains a particularly useful analysis of the various movements in this direction in this country, in France, and in the United States.

Following the adoption of the annual report, the chairman called upon Lord Sydenham to deliver his address on "National Reconstruction," the main part of which appears elsewhere in this issue.

Lord Sydenham's address contained many illustrations of the results of neglect of scientific knowledge and method, not only as regards omission to utilise directly the scientific resources of the country, but also in respect of a failure in the grasp and foresight such as sound scientific training would confer. Attention was directed to some latent sources of power in the British Isles awaiting development, and to the great resources of the Empire, which can not only produce all the great food staples and raw materials of every kind, but has almost a monopoly of some of the rarer metals and earths utilised in industry. While emphasising the paramount importance of allotting to science a larger place in national education, Lord Sydenham also expressed the hope that one result of the war would be a wider and loftier outlook on national problems and a greater willingness to sink individual claims in concerted action for the good of the community.

Mr. H. A. L. Fisher, President of the Board of Education, then addressed the meeting. Referring to the present methods of teaching science in our schools, Mr. Fisher said that he believed that such teaching was often quite efficiently conducted; and yet experience showed that we had not been successful in conveying the instruction in such a way as to grip the imagination of the children, and lead them to follow up and utilise scientific knowledge and method in later life. This was an old country, with old-established businesses, following traditional lines of development and having palpable defects. In the future it would be necessary for industries to be organised on a far greater scale, and with a fuller degree of co-operation between those interested; and also for science to be applied to these businesses in a much more complete manner than hitherto.

He had noticed a tendency to assume that scientific and technical instruction was necessarily divorced from the "humanities," and even inferior in its results from the point of view of making good citizens. He did not believe that there need be any such antagonism between these different branches of national instruction. It should be possible to give young people a scientific or technical training which, if conceived on broad and imaginative lines, would produce a sense of discipline and a development of character quite equal to that ascribed to the older discipline of orators and poets. Forms of technical training which did not equip the whole man were bad forms.

In conclusion, Mr. Fisher remarked that outside criticism, while sometimes needful, should be applied with discrimination and knowledge. An instance he had in mind of uninformed criticism was the charge not infrequently levelled against workers of slackness. No one who had not first-hand knowledge of the conditions under which work was being done at the present time should make such criticisms. He believed a great deal of harm had been done by workers being urged to efforts which were excessive and productive of overstrain.

Mr. H. G. Wells, who followed Mr. Fisher, said that he had long been an enthusiast for education, on which any attempt at reconstruction

must ultimately be based. If the education was right everything else would follow. He had followed the course of education in England for thirty years, and he was satisfied that all was *not* well with education in England. To defective education was due the general neglect of science and the habit of "muddling through." The radical defect, both in the schools and in the universities, was the undue predominance of classical studies. In the school the classical side had received almost all the encouragement, obtained the best masters, and was allotted the best boys. There was no room for science, modern languages, or knowledge of potential industrial value when so many hours were allotted to Latin and Greek. The effect was constantly perpetuated by the encouragement given to classical studies in the form of scholarships, and the greater opportunities given in the public service to men trained in classics. As a result those responsible for the country's destinies were mainly without knowledge or appreciation of science. When one considered that during an average youth's period of education he could not get in more than 5000 hours of real solid educational work, the importance of utilising these hours judiciously was evident.

Mr. Wells did not underrate what was wise and beautiful in Latin and Greek and ancient philosophy, and he regarded it as unfortunate that such knowledge was needlessly barred from the ordinary man by the insistence of pedants that it could be obtained only through the vehicle of the Latin and Greek languages. It was this insistence upon the rigid study of ancient languages which had raised a barrier between scientific and literary studies so that men of science and scholars tended to be separated into two camps, neither able to sympathise with or appreciate the aims of the other.

A vote of thanks to the Lord Mayor and the speakers closed the proceedings.

THE PUBLIC SERVICES OF INDIA.

IT is just thirty years since a Commission last reported on the Public Services of India. They have been years of remarkable social and intellectual progress, years in which the self-consciousness and political aspirations of educated Indians have developed surprisingly. It was time, doubtless, that a fresh stock-taking should be made.

The present report (Cd. 8382, price 4*s*. 2*d*. net) deals with all public posts carrying a salary of 200*l*. or thereabouts and upwards. These posts are roughly 10,000 in number, and since they all require a knowledge of English, they have to be shared between the Englishmen needed to maintain British control or required because Indians have not yet sufficient technical aptitude, and the $1\frac{3}{4}$ millions of Indians who have had an English education. Some 285 millions must, as matters at present stand, go without any share of the official loaves and fishes as represented by the 200*l*. limit, because they are illiterate in English. On the other hand, there is keen competition among them for the minor posts in which a knowledge of English is still not always required. After all, 200*l*. a year, in spite of a 30 per cent. rise in prices in ten years, is a comfortable competence in rural India.

The problem to which the Commission has addressed itself is that of giving a larger proportion than at present of the 10,000 better-paid posts to natives of India, including domiciled descendants of Europeans. It is a little surprising that, in dealing with the grievance that a large share of the official prizes falls to foreigners, the Commission has not noted the point, which any anthropologist would grasp at a glance, that the classes who, by their knowledge of English, share the 10,000 higher posts with Britons are, in fact, Indian cosmopolitans. They call themselves "Indians," not Parsis, Bengalis, Gujaratis, etc. They use English in their communications with one another. English, for instance, is the language of the National Congress. But in their intercourse with the 285 millions they must needs, like English officials, use the local languages. These, it must be remembered, are many more in number than the languages of Europe, and, unlike these, belong to five wholly separate families of tongues. It follows that an Indian serving out of his native province is every whit as much a foreigner, and, with regard to local observances and customs, may have as much to learn, as an Englishman. In the case of the semi-barbarous tribes of the hills and the N.E. frontier, educated Indians have been admittedly less successful than Englishmen in dealing with the people. To put it in another way, it were surprising, surely, if Europe were governed by benevolent Martians, that Englishmen should assert a claim to administrative posts, say, in Serbia or Bulgaria on the ground of their proficiency in Martian literature!

It must be admitted, on the other hand, that of the 10,000-odd better-paid posts only 42 per cent. are held by Indians. As the salary (and the responsibility) rises the proportion of Indians diminishes. At 500*l*. a year it dwindles to 19 per cent.; above 800*l*. it is only 10 per cent. This, put thus statistically, may seem a somewhat serious grievance. But the Commissioners themselves assert, as the result of two years of inquiry, that in the case of the Indian Civil Service (1411 posts) and the Police (926 posts) it is necessary to maintain a high proportion of Europeans in order to ensure the maintenance of British policy and prestige. They might have added, without excessive indiscretion, that a large part of the work of the Civil Service and the Police is precisely the protection of the mute millions from the classes from which the English-speaking Indians are drawn. Others of the twenty-four services into which the administration is divided, such as survey, railways (in the engineering branch), assay and mint, etc., are still chiefly recruited from the West because Indians with adequate technical training are not available.

It must be remembered, too, that the 10,000

coveted posts are divided between the Supreme Government and nine great provinces, each larger than most European States. This would give an average of 1000 posts to each, and an allowance of 500 or 600 Europeans to Delhi and each of the nine subordinate Governments does not seem excessive, especially when we recall the fact that there is a large European population in the great cities and in the planting and mining districts. It is well to give every scope, in reason, to the ambitions of the $1\frac{3}{4}$ millions. But the security and tranquillity of the country at large have to be considered.

The figures given by the Commissioners as to the rapidly extending amenities of life in India, of prosperity and education, are very striking. In twenty-four years the railway mileage had increased from 15,245 to 33,599 miles; the passengers carried from 111 to 437 millions; the freight tonnage from $22\frac{1}{4}$ millions to 87 millions. A deficit in earnings had been converted into a comfortable net profit of 4,750,000*l.* In twenty years the number of post offices had grown from 8349 to 18,789. In twenty-six years Indian exports jumped from 60,000,000*l.* to 166,000,000*l.*, and imports (a better guide to the spending powers of the people) from 43,500,000*l.* to 127,000,000*l.* So, in twenty-five years, the pupils in schools rose from $3\frac{1}{2}$ millions to 7 millions, and girl students from 278,000 to 1,000,000. Other branches of national life show the same marked and sustained progress.

The point for consideration is simply that the spread of prosperity and education tends to multiply the candidates for Government employment so enormously that the resulting feeling of grievance would not be wholly removed even if no imported agency were employed. The Commissioners have, however, suggested the recruiting of 25 per cent. of the Civil Service in India itself. With regard to the many services (smaller, of course, in their numbers) in which there is no question of maintaining British authority, and from which Indians are at present excluded only by want of scientific or technical training, the Commissioners have rightly said that the training should be supplied in India. But the means thereto, now that India is fairly prosperous and on the way to be more so, is to import well-paid European teachers under satisfactory conditions of service and pension. Men of the best type will be needed at home, and if they are to give their services to India, they should receive a sufficient wage. It will be money well spent in the long run, and, in fact, is the only feasible means of creating a large body of scientific technicians and experts in India.

THE NATIONAL IMPORTANCE OF FARM VERMIN.

SLOWLY but surely the public mind is awakening to the fact that the knowledge that has been obtained through long years of study and observation upon the life-history and habits of animals of all kinds that are injurious to crops is of real importance, and is likely during the next few months to be brought home very vividly even to the most casual. Scientific workers have for long pointed out that all facts hitherto unknown elicited from Nature were of value. Prof. Tyndall nearly fifty years ago told us to keep our sympathetic eye upon the originator of knowledge, but until quite recently such advice has been ignored, if not openly flouted.

For many years past it has been pointed out that the so-called balance of Nature was being disturbed by the thoughtless and ignorant action of certain individuals who openly destroyed owls and kestrels, sparrow-hawks, and other raptorial birds; in like manner the unrestricted increase of such birds as the wood-pigeon, house-sparrow, rook, starling, and blackbird was not only entailing a cruel hardship upon the farmer and fruit-grower, but these very same depredators were reducing the number of our beneficial or insect-eating birds to an alarming extent.

At last we have begun to realise that a *laissez-faire* policy is a mistake, and although somewhat late in the day, the different county, rural, and urban councils are endeavouring to take concerted action to destroy injurious birds and mammals. Excellent as such a movement is, if it has to have a permanent and beneficial effect a mandate from the Board of Agriculture or some other Government Department is needed that will not only permit of the destruction, but, what is equally important, compel the preservation, and to this end much more severe penalties are desirable for those destroying owls, kestrels, lapwings, and the truly insectivorous species of wild birds.

In view of the present shortage of food, which is likely to continue, in probably a lesser degree, for at least a year or two, it is highly important that we should realise the financial loss occasioned by the different species of wild birds and mammals. A recent writer estimates that the loss due to the house-sparrow reaches the incredible figure of 8,000,000*l.* per annum. We shall be well within the mark if we allow double that sum for the depredations of wood-pigeons, rooks, starlings, blackbirds, and other injurious species. It has been computed that the brown rat entails an annual loss to the United Kingdom of upwards of 15,000,000*l.* The losses due to voles and mice are difficult to arrive at, except in particular years, but it must be considerable. Indeed, it cannot be regarded as an outside estimate if we place the total losses due to the above pests at something like 40,000,000*l.* annually.

Now it is patent to any thinking man or woman that we are not doing all that we might, or even anywhere near what we might do, to lessen the enormous national loss. So long as wanton destruction of known beneficial animals is permitted, the unrestricted increase of known and proved injurious species ignored, and an apathy and indifference accorded by the powers that be to those who are endeavouring to awaken the

public mind on such matters, this enormous waste will continue, and in all probability increase.

It cannot escape observation that for many years past farmers, fruit-growers, and others have annually implored action, but it would seem that the very people who should have been primed with accurate information, and able quickly and decisively to have remedied the situation, are rather disabled than qualified for work of this character, which is of vital importance to the nation, and calls for immediate action.

WALTER E. COLLINGE.

NOTES.

WE learn from the "Political Notes" in the *Times* that Lord Balfour's Committee on After-War Trade has been strengthened by the addition of Sir William Pearce, Sir Charles Henry, Sir Archibald Williamson, and Sir William Priestley. The committee is now investigating the question of the possible introduction of the metric and decimal systems for our coinage, weights, and measures.

WHILE the wastage of the Yorkshire cliffs is to be deplored, the result is sometimes of advantage to the geologist and antiquary. Recently, in the vicinity of Scarborough, a fall of the cliff has revealed a hoard of twenty bronze weapons, which consisted of battle-axes, spears, chisels, gouges, portions of a sword, etc. Twelve of the axes, of the socketed type, are perfect. One shows the unusual feature of a rivet-hole in place of a loop for secure hafting; another contained a portion of the original wood shaft. Some of the axes are in the rough state, as if just turned out of the mould; others have obviously been in use. The collection evidently formed the stock-in-trade of a metal-worker of the Bronze Age, at least a thousand years before the Christian era. Mr. T. Sheppard, who has made a special study of the relics of this period, is figuring and describing the specimens, which have found a permanent home in the museum at Hull.

UNTIL recently our supplies of acetone, of which enormous quantities are now required in the manufacture of propellent explosives, have been largely obtained from foreign countries, where cheap supplies of waste wood were available for destructive distillation for acetone production. Since the outbreak of war, however, this position has been radically altered, and acetone is now produced in this country on a large scale by the distillation of wood and in other ways. The question is also being taken up in other countries of the Empire; it is proposed, for instance, to erect a factory for this purpose in Natal, where wattle wood will be used as a raw material. The possibility of similarly utilising the wattle wood accumulated in connection with the wattle bark industry of the East Africa Protectorate is also under consideration, and at the Imperial Institute an exhaustive series of trial distillations with this wood, and also with olive wood from the same protectorate, used locally as fuel, has just been concluded. The results show that the yield of acetone and acetic acid from both woods is satisfactory. A good yield of acetic acid is also being obtained in Ceylon from the distillation of coconut shells and various local woods. Attention is also being given to the subject in the Indian State of Mysore, and it seems likely that in a short time the Empire will be able to produce all the acetone and acetic acid it requires.

THE death is announced, in his seventy-ninth year, of Dr. H. B. Wheatley, who was clerk to the Royal Society from 1861 to 1879, and assistant secretary to the Royal Society of Arts from 1879 to 1908.

WE regret to see in the *Morning Post* of April 27 the announcement of the death of Sir Marc Ruffer, president of the Sanitary, Maritime, and Quarantine Council of Egypt, and formerly director of the British Institute of Preventive Medicine—now the Lister Institute.

THE *Nieuwe Courant* announces the death of Prof. Morjan Raciborski, professor of botany in the University of Cracow, and formerly for many years engaged in work on sugar-cane and tobacco in the Buitenzorg Botanic Gardens, Java.

THE valuable material collected by the special commission appointed to investigate the flora, fauna, and hydrology of Lake Baikal is to be published by the Imperial Academy of Sciences, Petrograd, in one volume, of which an edition of five hundred copies will be issued.

WE regret to note that *Engineering* for April 27 records the death of Mr. Andrew S. Biggart, in Glasgow, on April 26. Mr. Biggart was associated with the late Mr. William Arrol for thirty-four years, and took a prominent part in the construction of the plant used in connection with the Forth Bridge. He was a member of the Institution of Civil Engineers, and was noted for his interest in his workers. His death will be regretted by many who have benefited by his philanthropic schemes.

AT a meeting held at the Institute of Chemistry on April 27, the president and council presented a silver rose bowl to Mr. R. B. Pilcher, registrar and secretary, in appreciation of twenty-five years' faithful service. The meeting was well attended, and the presentation was made by the president, Sir James Dobbie, principal of the Government laboratories. Mr. Pilcher, who joined the staff of the Institute as clerk in 1892, was appointed assistant secretary in 1894, secretary in 1895, and has held the joint offices of registrar and secretary since 1900.

IT is announced that the next triennial prize of 300*l.* under the will of the late Sir Astley Cooper will be awarded for an essay or treatise on the subject of "Gunshot Wounds of the Lungs and Pleura." Candidates (who must not be members of the staffs of Guy's or St. Thomas's Hospitals, or their relatives) must send their essays, written in English, addressed to the physicians and surgeons, Guy's Hospital, London, S.E., on or before January 1, 1919. Full particulars concerning the conditions of the competition are obtainable from Mr. C. H. Fagge, Guy's Hospital.

THE sixteenth biennial Dutch Congress of Natural and Medical Sciences was held at The Hague on April 12 and following days. In connection with this, the geography section had organised an interesting historical exhibition, mainly of the work of Mercator and the Dutch cartographers of the seventeenth century. The chief general lecture was delivered by Prof. H. A. Lorentz, of Leyden, on "Einstein's Gravitational Theory and Fundamental Ideas in Physics." From a discussion, in one of the sections, on chemical industry in Holland, it appears that the manufacture of aniline and other intermediate materials for the dye industry was started in 1916.

THE annual meeting of the members of the Royal Institution was held on May 1, the Duke of North-

umberland, K.G., president, in the chair. The annual report of the Committee of Visitors for the year 1916, testifying to the continued prosperity and efficient management of the institution, was read and adopted. Sixty-two lectures and nineteen evening discourses were delivered in 1916. The following gentlemen were unanimously elected as officers for the ensuing year:—*President*, the Duke of Northumberland; *Treasurer*, Sir James Crichton-Browne; *Secretary*, Col. E. H. Hills; *Managers*, H. E. Armstrong, Sir W. Phipson Beale, Bart., C. V. Boys, J. H. Balfour Browne, J. Y. Buchanan, W. A. B. Burdett-Coutts, Sir J. Mackenzie Davidson, D. W. C. Hood, the Rt. Hon. Viscount Iveagh, Sir Charles Nicholson, Bart., the Hon. R. C. Parsons, Sir James Reid, Bart., Alex. Siemens, S. West, and the Rt. Hon. Lord Wrenbury; *Visitors*, Ernest Clarke, J. F. Deacon, E. Dent, Lt.-Col. H. E. Gaulter, J. Dundas Grant, W. B Gibbs, W. A. T. Hallowes, H. E. Jones, H. R. Kempe, F. Legge, J. Love. R. Pearce, Sir Alex. Pedler, H. M. Ross, and J. Shaw.

THE *British Medical Journal* announces the death on March 30, at sixty-two years of age, of Count Karl A. H. Mörner, professor and rector of the Royal Karolinska Medico-Chirurgical Institute, Stockholm. We learn that Count Mörner matriculated in 1872, and, after studying at Uppsala and Stockholm, qualified as a practitioner of medicine in 1884. Two years later his thesis on the pigments of melanotic tumours gained him the doctorate of medicine, and at the same time he was appointed professor of chemistry and pharmacy at the Karolinska Institute. In 1892 he was appointed rector of the institute in succession to Keys, and it was as the central figure of the institute that he was best known to the Swedish public. As rector he participated in drawing up regulations for the Nobel Prize Committees, and he was president of the Nobel Medical Committee.

WE regret to learn that Major Alasdair C. B. Geddes, R.F.C., a young naturalist of great promise, eldest son of Prof. Patrick Geddes, of Dundee, was killed in action in France on April 19. Mr. Geddes was commissioned in 1915, and gained very rapid advancement. He was recently awarded the Military Cross. His naturally fine powers of observation, cultivated by a singularly varied and active education, stood him in good stead in the discharge of his military duties. Alasdair Geddes kept up the tradition of the wandering student, learning at Montpelier and Paris, as well as at Dundee and Edinburgh, accompanying Dr. W. S. Bruce to Spitsbergen and his father's town-planning exhibition to India. He was keenly interested in botany and zoology, but perhaps geography held his heart. He graduated B.Sc. in Edinburgh in 1914, and was awarded the Vans Dunlop scholarship as the most distinguished science graduate of his year. He was passionately fond of music and the open country, and had an extraordinary power of compelling affection. All sympathy will go to his parents, who are in India, where Prof. Geddes has been doing Government work for three years in connection with town-planning. Major Geddes was only twenty-five years of age.

DR. S. TOLVER PRESTON, whose death took place in March at the hospital at Altona, near which town he had resided for many years, was educated at the University of Aberdeen, and while serving his articles with a London firm of engineers was employed on one of the Atlantic cable ships. He soon after retired from the profession, and in 1875 published his "Theory of the Ether," in which he attributed the gravitational attraction between two bodies to the oscillations of their molecules, which interact with the ether and set it in oscillation in turn. From about this period he appears to have lived abroad, chiefly in Germany, and in 1894 took his doctor's degree at Munich with a dissertation on the theories of gravitation. During this period he wrote several papers dealing with the kinetic theory of gases. He was the first to point out the possibility of obtaining work from a porous piston, separating hydrogen and oxygen at the same pressure from each other in a cylinder, by the more rapid diffusion of the hydrogen through the piston. Later papers dealt with cosmical physics. In one he pointed out that a rotating plastic solid would take a planetary form, and that it is not necessary to assume that the planets have at any time been liquid or gaseous.

DR. GEORGE CHRISTIAN HOFFMANN, formerly assistant director, chemist, and mineralogist of the Geological Survey of Canada, died in Ottawa on March 8. From an obituary notice contributed to *Science* by Dr. H. M. Ami, we learn that Dr. Hoffmann was born on June 7, 1837, in London, and studied at the Royal School of Mines. He spent several years as chemist in research laboratories of England, and later worked in Natal, Mauritius, and Australia. In 1872 he joined the technical staff of the Geological Survey of Canada, Montreal, under Dr. Alfred R. C. Selwyn. He was a fellow of the Institute of Chemistry, of the Royal Society of Canada, and of many other distinguished bodies. While in Australia he devoted considerable time in the phyto-chemical laboratory attached to the Melbourne Botanic Garden in Victoria; inquiries into the tanning properties of the barks of native trees; investigation into the amount of potash in various indigenous trees, besides experiments in reference to various acids, tar, and other products. His bibliography contains valuable reports and papers of analyses and determinations of Canadian ores, minerals, and economic products characterising the rock formations of Canada and elsewhere, including rare and new species.

WE regret to learn from the *Revue générale des Sciences* of the death of M. Henri Bazin Born at Nancy in 1829, M. Bazin was among the earliest of modern investigators into the phenomena of hydraulics, and his name is inseparably associated with the mathematical enunciation of the laws of fluid flow. In collaboration, at Dijon, with his chief and colleague, M. Darcy, and later, on the premature death of the latter, alone, he engaged in the preparation of a monumental memoir dealing with the flow of water in open channels and with the movement of waves. This was completed after seven years' labour, submitted to the Académie des Sciences, and published in 1865. It was his best and most prized work, and he returned to the subject again and again. In 1886, whilst still engaged at Dijon, he commenced experimental observations in connection with weirs, which lasted over a period of ten years. The results appeared in a series of communications to the *Annales des Ponts et Chaussées*. Nor did he content himself with applied science alone; in 1868 he found time to translate Salmon's treatise on algebra. Bazin enjoyed a great and well-deserved reputation as an experimentalist of the first rank; he was patient, indefatigable, and thorough. The science of hydraulics, in the noteworthy development which it has undergone during the past fifty years, is indebted to him for careful and painstaking explanations of many of those contradictory features in hydraulic phenomena which are the despair of the engineer, and render it so difficult

to reconcile satisfactorily the results of theoretical calculation with actual observation.

THE newly formed Russian Botanical Society held its annual, and also a special, meeting at Moscow on December 16–19, 1916, and its organisation was then completed. The following officers were elected: *Honorary President*, A. S. Famincyn; *President*, I. P. Borodin; *Vice-Presidents*, V. I. Palladin and S. G. Navašin; *Chief Secretary*, N. A. Buš; *Treasurer*, V. N. Suchačev; *Members of the Council* in Petrograd, V. L. Komarov, S. P. Kostyčev, and V. A. Transel. In addition, the following were elected on the council as representing cities containing a minimum of five members of the society: M. I. Golenkin (Moscow), E. F. Votčal (Kiev), V. M. Arnoldi (Charkov), B. B. Grineveckij (Odessa), V. V. Sapožnikov (Tomsk), Ja. S. Medvědev (Tiflis), and V. M. Arcichovskij (Novočerkassk). The number of the acting members of the society now exceeds 280. Notwithstanding the present unfavourable conditions, more than eighty members attended the four days' meeting in Moscow, and, in addition to the discussion and settlement of various questions of organisation, sixteen scientific reports were read. The next extraordinary meeting is fixed for December, 1919, again in Moscow. Thanks to a subsidy of 3000 roubles received from the Ministry of Public Instruction, it was possible towards the end of the year 1916 to proceed with the publication of the Journal of the Russian Botanical Society, and the first issue (Nos. 1–2) was placed before, and approved by, the Moscow meeting. The second issue (Nos. 3–4) is in the press and finishes the year 1916. For this year a subsidy of 10,000 roubles is being applied for, and it is intended to publish eight numbers of four to five sheets each. Thus the scientific amalgamation of Russian botanists, for which they have long striven, may be considered as achieved, and the formation under the auspices of the Imperial Academy of Sciences of the first all-Russian learned society is an accomplished fact.

IN the Journal of the Royal Anthropological Institute (vol. xlvi., July–December, 1916) Sir James Frazer's Huxley memorial lecture, "Ancient Stories of a Great Flood," is published. This subject was suggested by Huxley's article, "Hasisadra's Adventure" ("Collected Essays," vol. iv., London, 1911). He deals first in detail with the Babylonian and Hebrew versions of the story, and then passes on to consider the Greek myth of Deucalion. In regard to the last, he advances the interesting suggestion that the cleft in the Thessalian mountains, which is said to have been rent by Deucalion's flood, was no other than the gorge of Tempe. Indeed, it seems probable that the story of this flood was suggested by the desire to explain the origin of this deep and narrow defile. If this conjecture be accepted, the Thessalian story of Deucalion's flood, like that of Samothrace based on the tradition of the vast Ponto-Aralian sea and its desiccation through the piercing of the dam which divided it from the Mediterranean—in other words, through the opening of the Bosphorus and the Dardanelles—was an inference drawn from the facts of physical geography. In short, both were what Sir Edward Tylor has called "myths of observation" rather than historical traditions.

IN the *Review of Applied Entomology* (vol. iv., A and B, parts xi. and xii.; vol. v., A and B, parts i. and ii.) useful summaries of recent papers continue to be published. Those extracted from Russian and Scandinavian sources will be especially valued by British workers with a limited linguistic aptitude.

DR. ANGEL GALLARDO continues his studies of ants in the *Anales del Museo de Historia Natural de Buenos Aires* (vol. xxviii.), contributing systematic notes on the Attinæ of the Argentine, and a special illustrated account of *Trachymyrmex pruinosus*, with descriptions of observation nests.

TWO recent numbers of the *Bulletin of Entomological Research* (vol. vii., parts ii. and iii.) are noteworthy for some further papers by the Rev. Jas. Waterston on tropical chalcids; some of the new forms described are parasitic on injurious scale insects. There are also valuable papers by Dr. J. W. Scott Macfie on "West African Mosquitoes," of which one on the changes observed in the four larval stages of *Stegomyia fasciata* is of general interest to entomologists; the author points out the practical importance of trustworthy characters for the determination of such disease-carrying insects in the larval stage.

A VERY useful pamphlet on the destruction of the rodent pests of the farmer has been issued by the U.S. Bureau of Biological Survey. The rodents of North and Middle America include about 1350 forms; but of this number only a few species are actually troublesome to the farmer. When these pests become unduly numerous trapping is found impracticable, and the use of poison has to be resorted to. Careful instruction as to the employment of this is given. But the protection of hawks and owls, as well as of non-venomous snakes, is strenuously advocated. A number of photographs afford the reader a vivid idea of the widespread havoc these creatures may cause, if allowed to increase unchecked. British farmers might read these pages with profit.

IN the *Journal of the Franklin Institute* for March Prof. Ulric Dahlgren contributes a further instalment of his studies on the "Production of Light by Animals." He treats now of the Lampyridæ, known in this country as "glow-worms," but which Prof. Dahlgren calls "fire-flies," a term reserved by British coleopterists for another family, the Elateridæ. Both larval and adult forms are described in regard to their powers of luminescence, and the suggestion is made that the light-producing powers are dependent on the tracheæ, controlled by the nervous system, a conclusion already arrived at by Wielowiejski, of whom he makes no mention. Nor is the work of Dubois, who studied the luminescence of the true fire-flies, referred to. The last-named author believed that the light was evoked by the emission of blood, charged with "luciferine," to the luminous organs, where it combined with "luciferase," an enzyme formed in the luminous organs themselves.

THE current number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part ii.) contains an interesting paper by Dr. S. F. Harmer on that hitherto very imperfectly known member of the British marine fauna, *Phoronis ovalis*. This species was described so far back as 1856 by Strethill Wright, in the same papers in which the genus Phoronis was first established, a genus which has since given rise to an immense amount of discussion on account of its very problematical relationships. Curiously enough, up to the date of publication of Dr. Harmer's memoir, the species in question had never again been recorded, and considerable doubt had been thrown upon its validity. Its mode of life, rather than its rarity, is probably responsible for its having escaped re-discovery for more than half a century, for it inhabits burrows in the shells of mollusca, along with numerous boring animals, such as Cliona and Polydora. The original specimens came from the Firth of Forth, those examined by Dr. Harmer from the Northumberland coast. A detailed description of the anatomy is given, with numerous illustrations, and stress is laid upon

the striking powers of regeneration and multiplication by transverse fission. It is suggested that *Actinotrocha pallida,* found at Heligoland and Wimereux, is the larval form of *Phoronis ovalis.*

THE trustees of the British Museum have just issued the fourth report on Cetacea stranded on the British coasts. This is the work of Dr. S. F. Harmer, the keeper of the department of zoology in the British Museum (Natural History), and contains the records for 1916. In his preface Dr. Harmer tells us that the number of stranded Cetacea reported has continued to be adversely affected by the war, but it has reached twenty-nine, which is one more than in 1915. With the exception of a Sowerby's whale, from Lincolnshire, all the most interesting specimens have been obtained from the western, or south-western, coasts of England, Scotland, and Ireland. The value of these reports is beyond dispute, and it increases annually, since by the accumulation of such records an immense amount of material will become available, both as to the character of the Cetacean fauna of our seas and in regard to the migrations of these animals. Already it has become apparent that Cuvier's whale (*Xiphius cavirostris*) is not, after all, a very rare visitor to our seas, and what seems to be the first record of a specimen of this species recorded from the English coast is registered in this report. It was stranded in June last, at Watergate, Cornwall. A Sowerby's whale (*Mesoplodon bidens*) from Lincolnshire, a white-sided dolphin (*Lagenorhynchus acutus*) from Co. Mayo, and a young sperm whale (*Physeter catodon*), with uncut teeth—apparently a "sucker"—from Co. Galway, are other subjects of importance in this report. Finally, mention must be made of the stranding of a huge grampus, *Orca orca,* in the Solway Firth in May last. The flippers of this animal were of enormous size, and have been secured for the museum, where they have been dissected and casts, for exhibition purposes, have been made from them. They show many surprising structural peculiarities, which are to be described in detail in the near future.

MR. W. BICKERTON, in the Transactions of the Hertfordshire Natural History Society (vol. xvi., part iii.), records some interesting facts about the feeding habits of the greater and lesser spotted woodpeckers, which, during the months of December, January, and February, haunt osier-beds for the sake of feeding on the larvæ of some small fly which lives in burrows in the stems of willow twigs. To obtain these the bark is stripped from the twigs, enabling the larva to be extracted by the invader's tongue. So far the species to which this larva belongs is not known, but the authorities of the British Museum (Natural History) are said to be investigating the matter, from materials supplied by Mr. Bickerton. He believes that in this habit of bark-stripping we have an indication of the significance of the extreme density of the horny sheath of the woodpecker's beak. That is to say, this is not due in the first place to the needs of hewing tunnels through sound wood to secure a nesting-hole in hollow trees. Two other papers in this number will repay careful perusal. One of these is on the "Hertfordshire Bourne in 1916," by Mr. John Hopkinson, the other on the "Satyrid Butterflies of Hertfordshire," by Mr. A. E. Gibbs.

THE Cotteswold Naturalists' Field Club, with the assistance of the Rev. H. I. Riddelsdell, is making good progress in the collection of material for the compilation of the flora of Gloucestershire. As an instance of the new material collected up to the present, it may be noted that the chairman of the committee, the Rev. Walter Butt, announces, in vol. xix., part ii. of the Proceedings, that a collection of violets from the county was sent to Mrs. Gregory, of Cambridge, the leading authority on this flower, with the result that twelve new varieties were established for Gloucestershire, including, it is believed, *Viola rupestris,* Schmidt, the rarest violet in Great Britain, hitherto found only in Teesdale. Mr. Charles Bailey, who has recently presented his splendid herbarium to the Manchester University, has examined the list and describes it as "amazing."

THE Danish Meteorological Institute has published its annual survey of the state of the ice in Arctic seas for 1916. The publication, as usual, is in both Danish and English, and is supplied with charts for every month from April until August. No observations for the year were received from the Bering Sea, Beaufort Sea, north of Siberia, or Hudson Bay. Information is also wanting for the Kara Sea, despite the fact that a British steamer crossed it last summer. The abnormal conditions of the Spitsbergen ice, already noted in NATURE, were closely related with the conditions in the Barents Sea. After an abnormal westward extension of the ice, the pack receded in April almost to the coast of Novaya Zemlya, but advanced again in May and June. Even in June there was ice in the White Sea, and it was not until August that the Barents Sea was clear of ice to Nova Zembla and Hope Island. On the other hand, Iceland was unusually free of ice throughout the year, except during June and July. The Danish Meteorological Institute has also issued, as a separate publication, a useful summary of the ice conditions for the last twenty-one years in the Kara, Barents, Greenland, and Bering Seas, Davis Strait, and Baffin Bay. Charts are included for the months from April to August, showing the average limits, together with the maximum and minimum limits of the ice, and tables are given of the ice-covered area in the Barents and Greenland Seas for each of those months throughout the series of years.

ACCORDING to a paper published in the *Bulletin des usines de guerre,* the change in volume produced by hardening (quenching) steel is small if the hardening temperature is kept below a certain limit. Hardening in oil gives less variation in volume than hardening in water. Special metals, such as nickel-steel, show less diminution in volume than the carbon-steels. Eutectic steels "crack" more frequently than carbon-steels, which latter undergo considerable changes of volume. Finally, from experiments carried out, in flat pieces the tension is distributed uniformly in every direction, while in cylindrically shaped pieces the ends contract and become hollow, the piece bellying out.

DR. JOHN AITKEN's well-known papers on "Dust, Fogs, and Clouds" and on "Dew," originally published in the Transactions of the Royal Society of Edinburgh (1880, 1887), have been re-issued as one pamphlet by the council of the Royal Society of Edinburgh. The steady demand by the scientific world for copies of these papers having almost exhausted the parts of the Transactions in which they were published, the council felt it a duty to reprint them together as one pamphlet with the original paging. The importance of these papers has long been recognised by all workers in meteorology. They form together a pamphlet of ninety quarto pages, and copies may be obtained through the society's publishers, Messrs. Robert Grant and Son, 107 Princes Street, Edinburgh, and Messrs. Williams and Norgate, 14 Henrietta Street, Covent Garden, London, W.C.2, at a cost of 7s. 6d.

IN *Scientia* for January Mr. Philip E. B. Jourdain discusses the function of symbolism in mathematical logic. He maintains that until comparatively recently, symbolism in mathematics and the algebra of logic had the sole aim of helping reasoning by giving a fairly thorough analysis of reasoning and a condensed form to the analysed reasoning, which should, by suggesting to us analogies in familiar branches of algebra, make mechanical the process of following the thread of deduction; but that, on the other hand, a great part of what modern mathematical logic does is to increase our subtlety by emphasising "differences" in concepts and reasonings instead of "analogies." He points out the confusion of thought which has led many to believe that mathematical logic seeks to displace the free spirit of discovery or invention in mathematics, and the misunderstanding of the particular form of "economy of thought" used throughout mathematics and symbolic logic. He then deals with the function of this kind of economy and the necessity of observing the distinction between logic and psychology, and concludes by sketching some of the results of modern mathematical logic.

WE have received from the Cambridge Scientific Instrument Company List 134, which describes a measuring microscope for workshop use which can be arranged to measure horizontal or vertical lengths up to 4 cm. with an accuracy of 0·0001 cm. List 191 describes a thermo-couple potentiometer capable of reading up to 90 millivolts with an accuracy of a microvolt. List 912 describes the various forms of recording and index thermometers reading up to 540° C. They depend on the expansion of mercury enclosed in a steel bulb, a fine bore flexible steel tube, and a Bourdon spiral which actuates the pointer of the direct reading or the pen of the recording form of instrument.

"CHEMISTRY and Technology of Oils and Fats," P. J. Fryer and F. E. Weston, and "Naval Architecture," J. E. Steele, are in the press for appearance in the *Cambridge Technical Series* (Cambridge University Press). The following works are in preparation for inclusion in the same series: "Architectural Building Construction," W. R. Jaggard and F. E. Drury, vols. ii. and iii.; "Electrical Engineering," Dr. T. C. Baillie, vol. ii.; "Automobile Engineering," A. G. Clark; "Electro-Technical Measurements," A. E. Moore and F. Shaw; "Paper: Its Uses and Testing," S. Leicester; "Mining Geology," Prof. G. Knox and S. Ratcliffe-Ellis; "Textile Calculations—Materials, Yarns, and Fabrics," A. M. Bell; "Laboratory Note Book for Applied Mechanics and Heat Engines," F. Boulden; "Elements of Applied Optics," W. R. Bower; "Electric Installations," C. W. Hill; "Accounting," J. B. Wardhaugh; "Chemistry for Textile Students," B. North and N. Bland; "Dyeing and Cleaning," F. W. Walker; "Experimental Building Science," J. L. Manson, vol. ii.

OUR ASTRONOMICAL COLUMN.

PERSISTENT AURORA.—By taking advantage of the sensitive spectroscopic method of detecting faint aurora, Dr. V. M. Slipher has obtained further evidence of a permanent illumination of the night sky by auroral light (*Popular Astronomy*, vol. xxv., p. 274). A large percentage of the luminosity is concentrated in the yellow-green line about λ 5572, and exposures of only a few hours were sufficient to give impressions with the small spectrograph employed. From June, 1915, to November, 1916, upwards of fifty exposures were made at Flagstaff on different parts of the sky, and the characteristic line appeared in all the photographs. The observations suggest that the auroral light is more intense towards the horizon, and possibly towards the sunrise and sunset points of the sky, but more extensive observations are necessary in this connection.

A NEW CATALOGUE OF DOUBLE STARS.—An important catalogue of the double stars discovered visually since 1905 has been published as vol. lxi. of the Memoirs of the Royal Astronomical Society. The author is Mr. Robert Jonckheere, a well-known observer of double stars, who was director of the observatory of the University of Lille until the events of the war drove him to England as a refugee in October, 1914. The exile thus abruptly forced upon him has given Mr. Jonckheere the opportunity of completing the present catalogue. Most of Mr. Jonckheere's own observations were made at Lille with an equatorial refractor of 14-in. aperture, but since his arrival in this country he has made extensive use of the 28-in. refractor at Greenwich. The catalogue, however, is not exclusively devoted to the author's discoveries and measurements. It includes all the double stars to the year 1905 which were not included in Burnham's general catalogue of 1906, and all the pairs discovered from that date to the end of 1916, the term "double star" here being applied only to those of separation less than 5″. The limit of N.P.D. is 105°, and the positions are given for the epoch 1920. The total number of entries is 3950. The catalogue is conveniently planned, and will doubtless greatly facilitate the work of double-star observers.

REPORT OF MOUNT WILSON OBSERVATORY.—Prof. Hale's report on the work at Mount Wilson during 1916 records new and significant advances in several departments, many of which we have already noted. The first place is naturally given to the spectroscopic method of determining the distances of stars, which is now considered to be established as a fundamental contribution to practical astronomy, and has already afforded valuable confirmation of the conclusions of Russell and Hertzsprung regarding the existence of giant and dwarf stars. Scarcely second in interest is the investigation of periodic spectral changes in the Cepheid variables, which must have a significant bearing upon the interpretation of stellar types as well as upon the nature of the variables of this class.

The use of the new 13-ft. spectroheliograph has revealed the vortex structure about sun-spots in exquisite detail, and certain other investigations have suggested that the forms recorded represent hydrodynamic phenomena rather than lines of force of the magnetic fields underlying the spots. No trustworthy evidence of the Stark effect in the sun has yet been obtained, but further work on the general magnetic field of the sun has confirmed the conclusion that the magnetic axis does not coincide with the axis of rotation; it is inclined at an angle of 5·2°, and revolves in a period of 31·51 days ± 0·62 day. A new map of the sun-spot spectrum has been completed for the region λ 6450 to λ 6000, and the large scale of 1 cm. to the Ångström is sufficient to show the chief Zeeman phenomena.

Important results have also been obtained in studies of star clusters and nebulæ, and in laboratory investigations.

Good progress has been made with the 100-in. reflector, and it is hoped that this giant instrument will be in actual use in the near future.

THE PAY AND SUPPLY OF TEACHERS.

THE striking facts and figures given in the presidential address recently delivered by Mr. T. H. J. Underdown to the National Union of Teachers, and published in NATURE of April 19, show that the whole fabric of our primary educational system is seriously threatened with disaster. Unhappily, the secondary and technical schools of the country are faced with the same danger from precisely the same causes. The systematic underpayment of the teachers and the resultant shortage of the supply must cause grave misgivings to all who have a real conception of the value of a good secondary education and its necessity, if success is to be achieved in the future in the various branches of commercial and scientific activity. Our national efficiency depends to a large degree upon the quality of our secondary education, and any such education worthy of the name will be impossible unless the present conditions of service obtaining in the teaching profession are radically and speedily altered.

It is characteristic of our national indifference towards education that, not merely the man in the street, but apparently also the leading members of scientific and commercial circles, have no knowledge of the utterly insufficient salaries paid to those upon whom the important duty of training the future generation falls; or, at best, if they have cognisance, they throw the responsibility upon the local county or borough authority, and wash their hands of the whole business. A sufficient proof of the inability of the local authorities to manage education under present conditions is evinced by the figures quoted by Mr. Underdown, and by the fact that the average salary paid to the assistant-masters in the aided and maintained secondary schools of the country, as shown by an inquiry made by the Incorporated Association of Assistant-masters just prior to the outbreak of war, is 175*l.* 10*s.* If the nation expects to continue to get highly trained, competent teachers, necessarily men of culture and education, who have laid out a large amount of ability and close study, to say nothing of money, for 3*l.* 7*s.* 6*d.* per week, the nation is making a huge blunder. Like any other business concern, it will get, in the long run, just what it pays for. Much has been written during the past year concerning the lack of science and scientific training in secondary schools in general, but is it to be expected that a really able and scientific expert will take up teaching with the above figures before him? The difficulty is accentuated by the ever-increasing demand for these experts from the various branches of manufacture and industry, and by the migration of teachers generally into more remunerative and less arduous spheres of work.

A large number of authorities and schools make no provision for systematic increase, while the following tables show the inadequacy of the scales that do exist:—

Maxima	England: County Councils	England: County Boroughs	England: "Published Schools"	Wales
Above 250*l.* ...	1	1	2	—
201*l.*–250*l.* ...	6	12	5	5
200*l.*	7	12	11	2
Above 180*l.* and below 200*l.*	3	6	2	1
180*l.* and below	—	14	26	10

Notes—(i) Figures for July, 1914.
(ii) Special cases excepted as being outside the range of the ordinary qualified assistant.

To quote a typical case, the maximum for honours graduates after sixteen years' service is 190*l.* Another has 160*l.* as the ultimate reward for ten years' service. Other "scales" have Gilbertian maxima. Two are as low as 130*l.*, and five are below 150*l.*

The actual salaries received will show that our educational experts have been trying to run education upon the principles of lowest tender and cut prices. Some seven or eight university graduates receive less than 100*l.* a year. One Oxford M.A., after fifteen years' service, gets 120*l.* Only 18 per cent. of the masters receive more than 200*l.*

The grudging and meagre response to the demands of the teachers for a war allowance affords a glaring insight into educational administration and its reaction upon its employees. To quote, or, rather, misquote, from one of our most successful and popular teachers: "Those who polish the floors and those who survey the roads can be generously treated, but those who polish the brain are asked to wait for more opportune times, or are put off with a dole equal to an office boy's increment of wage—forsooth, because they are so many and the rates must be kept low!"

We note with pleasure and endorse thoroughly the recent statement of the President of the Board of Education that "the calling of secondary-school masters has yet to be made reasonably attractive to a really able man. . . . Somehow or other we must attract these men"—and may *we* add "keep them"? The proposed remedy—an additional grant of 433,900*l.*, of which a part is to be handed over to the authorities and schools, of which a part again is to be allocated to more or less spasmodic increments of salary—will cover only a portion of the recent increase in the cost of living. The sum is admittedly only a beginning, but the situation demands methodical measures even more urgently than it does money. Before it is too late, the country should insist upon the establishment of a regular and national system of payment, if the prospects and status of the profession are to be raised to such a level that it can fairly compete with the other professions for the best intellects from all classes and spheres of life.

Experience shows that the majority of the local authorities fail to realise the national unity of education. The average councillor thinks in terms of bricks and mortar, and so long as he regards education as one of the branches of architecture, so long will the real management remain in the hands of highly paid clerks and secretaries, who, however zealous they may be, work in watertight compartments, and have no interest in making education a national concern. Efficiency in education stands or falls with the man who actually teaches, and no amount of expensive inspectorial or administrative officialdom will compensate for the cheeseparing policy of underpaying the teachers.

Amongst the multiplicity of reforms rightly being advocated at present are included the extension of the school-life and the expansion of the facilities for secondary education. Official figures show that there are only 84,000 pupils between the ages of fourteen and eighteen in England attending grant-earning secondary schools, of which merely 21,000 remain at school to an age beyond sixteen years—an age of expanding receptive faculties, at which moral training is of inestimable benefit. It has been estimated that an army of 20,000 teachers of the secondary school type will be required, in addition to the 10,000 already available, to staff the secondary schools proper, the junior technical schools, the day continuation schools, and the part-time trade schools of the near future. A great part of this number must have expert scientific knowledge combined with training. Under the existing conditions, the supply of teachers is quite

inadequate and is rapidly diminishing. The supply of teachers in grant-earning schools is at present largely derived from the pupils passing from the primary schools to the secondary schools, there to be maintained out of public funds almost entirely throughout their scholastic career. Education authorities, in their endeavours to obtain the necessary staffs, have adopted the doubtful policy of attracting pupils to the profession by the offer of educational facilities and increased maintenance allowances, in some cases despite the moderate standard of ability displayed.

However anxious the Government may be to embark on far-reaching schemes, it will fail unless the supply of the men who are to carry out those schemes is present; and the supply of men of the right type will not be forthcoming unless (1) a national minimum salary scale of really adequate terms is established for all teachers in secondary schools; (2) teachers are free to move from one area to another without loss of position, salary, and pension rights.

Such a system would do away, once for all, with the present enormous disparity in the salaries of different men with the same qualifications engaged in the same work and in similar areas.

The present time affords an excellent opportunity of introducing a system obviously necessary and long overdue. It is to be hoped that the Government will not adopt the futile policy of trying to patch up here and there, but will lay the foundation of a national structure in which every child shall enjoy, as a birthright, the most suitable and valuable education compatible with its capability.

G. D. DUNKERLEY.
ALEX. BLADES.

SOIL AERATION IN AGRICULTURE.

SOME time ago (NATURE, February 24, 1916, vol. xcvi., p. 716) we directed attention to a paper by Mr. and Mrs. Howard, of the Agricultural Research Institute, Pusa, on the ventilation of Indian soils. "More air and less water" was then set before the native cultivator as the secret of successful crop production. With characteristic enthusiasm for his subject, Mr. Howard has since developed this idea in a lecture given during a meeting of the Board of Agriculture at Pusa, and now published as Bulletin No. 61 of the Agricultural Research Institute. Although discussed chiefly in relation to Indian conditions, and particularly the alluvial soils of the Indus and Ganges valleys, the subject in its broader aspect is of universal importance to agriculture. The heavy rains of the monsoon falling on these soils, which consist largely of small particles of fairly uniform size, cause the surface to run together and form a crust; the soil loses its porosity and aeration is impeded. The remedy advocated is the incorporation with the first foot of soil of *thikra* (tile fragments) at the rate of 50 tons per acre. Leguminous plants like gram respond at once to the improved aeration. Nothing is said as to the cost of this treatment, or if it can be applied commercially over considerable areas.

Java indigo is another leguminous plant of special interest, and about this Mr. Howard has a great deal to say in relation to soil aeration. He holds that the variable dyeing power which has greatly handicapped the natural indigo in competition with the synthetic product of the German factories is due to defective and irregular aeration. The indigo plantations of Bihar lie on the higher ground of an undulating country with rice in the valleys between. During the monsoon all the country becomes more or less waterlogged except the crest of the ridges, and occasionally some of these go under. The high-water mark is said to be rising at the rate of 3 in. a year, owing to increasing interference by embankments (canal, rail, and road) with the natural drainage of the country. Mr. Howard suggests that "when a railway has to run across a broad, shallow drainage line, it might pay to lay it flat and to let the water run over it. At most the interruption of traffic would not be a very long one." It would be interesting to hear what the permanent-way departments and traffic superintendents of the Indian railways think of this idea. Whatever the cure, it is evident that the activities of the civil engineer have been harmful to agriculture in some ways, and a good case is made out for a thorough study of the drainage systems of India from this point of view.

With regard to water supply, the author goes even further than in his previous paper, and suggests that some of the money now wasted on over-irrigation might more profitably be spent on aerating stations for the supply of oxygen to the insufficiently aerated water of the rice swamps. In this connection a sharp distinction is drawn between rice and other plants which is difficult to follow. It is said that while the former takes up its oxygen in the dissolved state from the swamp water, other plants, *e.g.* wheat, assimilate it as free oxygen. As the root-hairs of the wheat plant must be in contact with moisture if they are to function properly, it is probable that oxygen, like other plant foods, passes in solution through a film of water surrounding the roots. Wheat, barley, and peas all grow well in water culture so long as the nutrient solution is kept aerated. If the supply of dissolved oxygen falls off, the plant suffers at once, even if the upper roots have access to free oxygen. The distinction between swamp rice and wheat seems rather to be that the former requires much water and relatively little oxygen, while the latter needs a moderate amount of moisture and much oxygen. Under favourable conditions wheat obtains this by the rapid passage of the gas through the water films surrounding the roots and soil particles.

Turning homewards, the variation in the quality of malting barleys grown on different British soils is shown to be due to soil aeration. The best malt comes from the light land where natural aeration is good. One effect of the expensive organic manure used by market-gardeners and hop-growers is to increase the aeration of the soil and encourage root development. It is suggested that a permanent aerator like the Indian *thikra* might achieve the same result at a lessened annual charge for manure.

We have only touched on a few of the many interesting points raised in Mr. Howard's lecture, which deals with one of the most important factors in crop production. Although the necessity for soil aeration has been unconsciously recognised ever since man first drove a spade into the earth, because of its very obviousness agricultural science has scarcely given the subject the attention it deserves. E. H. R.

THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE.[1]

THE genetic relation between the serious pursuit of natural science and the profession of medicine is nowhere better illustrated than in British India, and in British India nowhere better than by the Asiatic Society of Bengal (the original "Asiatick Society"), and by its autochthonous congener, the Indian Association for the Cultivation of Science, founded in 1876

[1] Report of the Indian Association for the Cultivation of Science for the Year 1914. (Calcutta, 1916.)

by Dr. Mohendro Lal Sircar, a practitioner of medicine in the Indian quarter of Calcutta.

At a time when Indian universities were the purely examining bodies so dear to the Philistine soul, when secondary education in India was mainly bookmongery (to call it "literary" would be a fault to heaven), and literary gentlemen were brought from England to feed raw Indian youths with husks of commentary laboriously ground from the English classics, Dr. Mohendro Lal Sircar, a medical man immersed in the anxieties of a private practice, was probably the only educated Indian in Bengal whose ideas of education were approximately those held generally to-day by men of science in Great Britain.

Dr. Sircar, being beyond his learning and accomplishments a man of great sagacity and urbanity, did not agitate or make a noise, but, with single-minded devotion to higher issues, he set a-going in a convenient part of his native town, and for many years carefully fostered, a society much of the style of the Companies of Friends of Natural History, the aim of which, to begin with, was, and had to be, generally educative. This society was appropriately called an association for the cultivation of science. By degrees, and by the accretion of laboratories for particular studies, the institution, while retaining an educational character, advanced to the differentiated technical stage; and now, beyond its educational purpose, it has become a well-organised and well-equipped institution for original experimental research.

The report for the year 1914, lately received, shows that in addition to the seven regular courses of lectures on different branches of science delivered to students, there emanated from the association ten original papers—four on physico-mathematical subjects, five chemical, and one biological.

NATIONAL RECONSTRUCTION.[1]

THE British Science Guild, during the twelve years of its existence, has earnestly endeavoured to promote the public and official recognition of scientific research and of scientific organisation and methods as essential factors in national progress. Our journal and our annual reports show the matters to which we have striven to direct attention. It is not our object to secure the advancement of any particular branch of science; each has an association created for that purpose. We seek to provide what may be called a clearing-house of progressive thought, in order that activities which are mutually dependent may be harmonised for the welfare of the State and the Empire, and that the application of scientific knowledge not only to industries, but also to every department of public life, may become a reality. We believe that thus only can our future national advancement and the well-being of our people be placed upon a sound and an enduring foundation.

These are objects which in the past have powerfully appealed to men of science whose vision extended beyond the horizon of their labours to the conception of a State in which research was not only encouraged as a primary necessity of progress, but the results were quickly applied to the direction of energy, the prevention of waste, and the conservation of the forces on which the prosperity of mankind mainly depends.

Before the war, these were voices "crying in the wilderness." Governments and Parliament, which is supposed to control and inspire them, cared for none of these things. In our great public offices science was apt to be regarded as an abstruse mystery which possibly concerned business men and might sometimes obtrude itself inconveniently upon public attention, but had no part or lot in the administration. Speaking broadly, we have been ruled by men for whom scientific conceptions and scientific methods had little or no interest; and partly from this cause our industries were being stealthily undermined and were passing into the control of another people which had laboriously organised all its public and private activities, had been carefully trained quickly to turn scientific discoveries—largely borrowed—to material advantage, and had become obsessed with the mad ambition of imposing its theories of life and conduct by force upon the world.

The war has had the effect of turning a strong searchlight upon the innermost workings of our national life. Our weakness and our potential strength stand plainly revealed. We can see how severely we have suffered and must still suffer from our neglect in the past; and if we strive to ascertain causes, we cannot fail to reach the conclusion that our lack of appreciation of all that science, using the term in the broadest sense, could have conferred upon us lies at the root of many present difficulties. When the question of contraband was being considered, science could have told us what was vital to the prosecution of war by an enemy, and what, therefore, we should use every effort to exclude from his territories. Sir William Ramsay, whose loss, as one of our greatest leaders of scientific thought, we deplore, pointed out the gross fallacies which were permitted to mislead our policy in regard to cotton. Lard was assumed by one of our rulers to be innocuous, because he was unaware that its use for the manufacture of glycerine was an old discovery. The painful revelations of the Dardanelles Commission establish the facts that a fateful decision was arrived at by methods which flagrantly violated scientific principles, and that a complete misunderstanding as to some elementary artillery matters was allowed to exist. And now in the handling of the difficult question of man power there is an evident want of the grasp which sound scientific training can confer.

It would be easy to multiply instances of the ways in which the absence of scientific habits of thought have prejudiced the conduct of the war; but there is another side which must not be forgotten. If we have too often failed in foresight and in the application of orderly methods to the direction of policy, the national genius for improvisation has been strikingly manifested. On the basis of a small Army, the best we ever possessed, we have built up, transported across the seas, equipped, and supplied vast national forces which have shown fighting power unrivalled in our military annals, and have determined the final victory of the cause of the Allies. And further, under the stress of war, we brought science to bear on military requirements in such a way as not only to overtake, but to surpass, German appliances laboriously prepared in years of peace. On a different plane, the war savings propaganda is a good example of well-conceived and successful effort. Nothing can be more certain than that we possess organising capacity, which, if turned to full account, can perfectly respond to the future needs of the Empire.

Reconstruction is now beginning to occupy the minds of all thoughtful men and women. After-the-war problems are being widely discussed, and amid their baffling complexities some great principles stand out as signposts along the path which we must follow.

The material prosperity and the financial stability of the country can be restored only by an increase of production and interchange. This implies the creation of new industries and the economic development of those which exist, combined with a firm hold on old markets

[1] From the presidential address delivered at the annual meeting of the British Science Guild, held at the Mansion House, London, on April 30, by the Right Hon. Lord Sydenham, F.R.S.

and the development of new ones. If our national resources were exhausted, we might well despair of the future; but the resources of the Empire are almost inexhaustible, and their utilisation is only beginning. The Empire can produce all the great food staples—grain, meat, sugar, and fats—sufficient for the supply of a far larger population than it now contains. The fish supply could be very largely increased from Ireland and the banks of Newfoundland. Raw materials of every kind, coal, and mineral oil abound. The Empire has almost a monopoly of some of the rarer metals and earths of which science is making more and more use. We have first to make certain that never again shall Germany obtain control of our raw materials and our key products, and then to ensure that our materials are, so far as possible, manufactured within the Empire. Before the war, almost the whole of the Imperial production of palm kernels went to Holland and Germany, and the oil expressed from them was exported to the United Kingdom as such, or in the form of margarine and other prepared fats. The story of the Australian zinc concentrates is well known. They and the output of Australian copper were discovered to be in German hands when war broke out, as was a great part of the manganese and hides of India. The resources of the Empire amply suffice for the rebuilding of our national prosperity, if by the unstinted application of science in the laboratory, in the workshop, and in the superior direction of commerce and industry they are turned to the fullest account.

The handling of the great question of the supply of power cannot be left to piecemeal treatment. We now have a Board of Fuel Research, which, in co-operation with the British Assciation, is investigating economics, and already an annual saving of fifty million tons of coal is known to be possible. Mr. Newlands estimates that in Scotland more than 1,000,000 electrical horse-power could be obtained from water, and he points out that, in Switzerland, one electrical horse-power obtained from water costs *1l.* 19*s.* per annum, as compared with *4l.* 11*s.* 8*d.* in England from coal. The economic advantage of employing water power, wherever practicable, is manifest, and in parts of India, as elsewhere within the Empire, there are resources which need to be turned to account. In matters of such broad importance as power, lighting, and heat, research on the widest scale is necessary, and when conclusions have been reached their application can be secured by the active co-operation of the interests involved assisted by intelligent legislation.

In trade, the first requisite is sound information kept up to date, to which the Germans owe much of their success. We now have four Trade Commissioners representing the Dominions, and India must be similarly provided; but the whole system of consuls and commercial attachés in foreign countries requires complete reorganisation, which Government can carry out only by seeking and following the advice of experienced leaders of commerce.

The Dominions Commission has shown the immense resources of the Empire, and in its final report it directs attention to the importance of cheap, speedy, and efficient transport between Imperial ports. Some years ago I proposed the establishment of an "Imperial Maritime Council," composed of fifteen representatives of the various parts of the Empire, and financed by a 1 per cent. *ad valorem* surtax upon all foreign imports into Imperial ports, which in 1904 would have provided an annual income exceeding 4½ millions. The council was to deal with all matters relating to the maritime communications of the Empire, to build up inter-Imperial transport, and to ensure close study of the means of developing Imperial trade as a whole. The Dominions Commission has now recommended the formation of an Imperial Development Board for these and other analogous purposes. This would be a great step in Imperial reconstruction, leading to far-reaching results, provided that the board were executive, amply provided with funds, and completely severed from politics at home and overseas.

We have now a Department of Scientific and Industrial Research with a State endowment of one million, which will be able to exercise some of the functions of the Board of Science that the British Science Guild has strongly advocated. Each of the Dominions and India will require the same machinery, and Mr. Hughes has undertaken that Australia shall be thus provided, while the Canadian Government has appointed an advisory council to advise a committee of the Cabinet on all matters relating to scientific and industrial research. We have also a Board of Scientific Studies which is carefully investigating our requirements. Systematic and co-ordinated research on a large scale is a primary need, and waste or duplication of effort can be prevented only by such general direction as to ensure that problems are attacked in the localities most favourable to their solution. Special attention must be given to chemistry, which has many important secrets to yield. "The country," said Sir William Ramsay, "which is in advance in chemistry will also be foremost in wealth and general prosperity." We have certainly fallen behind Germany in this vitally important branch of science, not in the ability and insight of our chemists, but in numbers and in the application of chemical discoveries to industry. It is upon chemistry, the use of power, and co-operative methods that agriculture must mainly depend for advancement.

National reconstruction will require in the future the sustained stimulus which education alone can supply. In our public schools and colleges science must take the place to which it has been long entitled. While trained specialists will always be relatively few, all who are destined to play a part in national affairs must receive such a grounding in the natural sciences as to ensure that physical laws and facts will appeal to them, and that scientific methods of thought will become habitual. For this reason, the British Science Guild has strongly urged that a knowledge of science should be required of all candidates in examinations for the Civil Service. There need be no conflict with what are not well described as "humanistic studies." A broad general education is the best foundation for science training, and in so far as literary studies develop breadth of vision and clearness of style, they are valuable helps to the future specialist. Conversely, such subjects as history take new form when they are approached in a scientific spirit.

A Parliament or a Government composed of specialists would be unsuited to its duties; but both need an intelligent appreciation of the relation of science to national life which is now conspicuously lacking. "Mankind," writes Prof. Dewey, of Columbia University, "so far has been ruled by things and by words, not by thought. . . . If ever we are to be governed by intelligence, not by things and by words, science must have something to say about *what* we do and not merely about *how* we may do it more easily and economically."

Apart from what we understand by science teaching, there is the technical training which is needed by foremen and workers in industries, which should be such as to help the abler man to rise. The Departmental Committee on Juvenile Education and Employment has recently reported, and its main proposals are the retention at school of all children up to the age of fourteen, with attendance at continuation classes of

at least eight hours a week up to eighteen. These classes are "to include general, practical, and technical education," and they will probably in many cases take the form of trade schools carrying on the education of young workers who have found employment. The advantages of manual training in primary schools are not sufficiently emphasised in the report. Manual dexterity can be acquired at an early age, and boys might thus gain a truer conception of the dignity of hand labour, while experience shows that technical or elementary scientific knowledge, if attained by practical work, becomes a permanent possession. Greater differentiation between the work of rural and of urban schools is another pressing need.

No one can maintain that our system of primary education has been a failure. As the President of the Board of Education pointed out the other day in his admirable speech, we owe to it, in part at least, the new armies which have brilliantly upheld our national honour on many stricken fields. But we believe that education can do more in the future in developing moral strength and in inculcating the sense of duty and good citizenship. Mr. Fisher has laid down as the ideal of his office that it should build the foundation "for a patriotic and social education worthy of the genius of our people, and a fitting monument to the great impulse which is animating the whole people in the war." We all hope he will be spared to realise that high ideal.

In the tremendous tasks which lie before the nation, Government can play an important part. Statesmanship worthy of the name must lead, inspire, direct, and initiate. In guiding education, assigning defined functions to experts carefully selected for special purposes, exercising their enormous patronage with a single eye to knowledge and efficiency, as well as in encouraging the progress of applied science, and guarding against legislation which may hamper trade and industrial activity, there is ample scope for the action of Governments. Interference in the management of business enterprises will usually be harmful, since, for well-known reasons, the conduct of business affairs by officials in democratic countries is rarely efficient.

Some tariff adjustments may be found desirable; but the idea that national prosperity can, in the long run, be assured by fiscal devices is baseless. In so far as tariffs can stimulate the operation of natural laws, they may be beneficial. When they aim at producing artificial conditions in defiance of law, they usually defeat their ends. They may be used legitimately, and we have been told that they will be used to further the development of the resources of the Empire, and the object having been attained, they can be dispensed with.

I have only dealt with reconstruction in the material sense, which cannot alone guarantee the purer and happier national life which we all earnestly desire. That can be reached only if the whole nation will, in the difficult times that lie before it, follow the shining examples of duty, discipline, and self-sacrifice which have been set by our heroes on the seas, in the field, and in the air. The men who have constantly faced death and shared in dangers and hardships will come back with a new outlook on life. In the trenches there have been no party divisions, no attempts to set class against class, but only shared efforts which are bringing certain victory to a sacred common cause. May we not hope that the great lessons learned by our best manhood in the storm and stress of war will react upon the nation as a whole and render the forms of politics to which we have grown accustomed impossible in the future? The strife of parties and of individuals contending for office and power, the intrigues which have not wholly ceased during this crisis in our fate, the machinery by which party chests are filled and constituencies are manipulated, the false discipline which, by preventing men from voting according to their knowledge and conscience, vitiates the decisions of Parliament upon vital issues; the triumph of words over experience and powers of action—all these things and more have had their day, and we begin to realise the inevitable results.

Reconstruction in the highest and fullest sense can be achieved only by a great national party, seeking solely the welfare of the commonwealth, examining every public question from the view-point of the interests of the community as a whole, and choosing leaders irrespective of class or party, who can be trusted to bring a lofty patriotism and trained intelligence to bear upon the vastly complex and far-reaching problems with which we are now confronted. If these are only visions, then I see no certain prospects of restoring the shaken fabric of the State, of rebuilding our prosperity on a broader and an enduring foundation, of healing the open wounds in our body politic, and of wresting lasting good from the gigantic evils of war.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ST. ANDREWS.—The University museum has just received the entire collection of local and other birds, many very rare, made by Misses Baxter and Rintoul (of Largo and Lahill), for years known as authorities on ornithology, and joint editors of the *Scottish Naturalist.* They have, moreover, in interpolating these, gone over the entire University collection of birds and re-arranged and labelled them. Accompanying this noteworthy and valuable gift, for most are exquisite examples of the taxidermist's art, are eight cases with drawers containing named collections of the eggs of birds and of Lepidoptera and other insects, as well as a few skulls and stuffed mammals.

DR. P. MARIE has been appointed to succeed the late Prof. Dejerine as professor of clinical neurology in the University of Paris.

FRÄULEIN A. M. CURTIUS, recently appointed lecturer in French by the philosophical faculty of Leipzig, is, according to the *Nieuwe Courant*, the first woman on the staff of a German university.

THREE research fellowships in, respectively, pathology and bacteriology, medicine, and surgery have been endowed in the University of Chicago by Dr. F. R. Logan, who has given a sum providing an income of 600*l.* a year for the purpose.

IN his presidential address to the Institution of Mechanical Engineers on April 20, Mr. Michael Longridge considered the provision in this country of technical education for engineers. Many persons, he said, still fail to understand that the manual training which enabled an apprentice to become a master craftsman in times gone by does not suffice to turn a schoolboy into an engineer to-day. Differentiation is needed now in the training of the various classes of engineers and workmen, and it is this lack of differentiation which seems to be one cause of the inefficiency of our technical education relatively to its cost. The education available for the higher ranks of engineering is fairly satisfactory in Mr. Longridge's opinion, but that provided for the workman, both general and technical, is most unsatisfactory. "Yet the workman must have better education to qualify him to rise if capable, and to give those who have not the ability to rise some interests outside their daily work and football matches, and also to lessen drunkenness. The need will become

greater as repetition work and automatic machinery replace varied jobs and manual skill. Unless an antidote be provided, the monotony of this kind of work will crush initiative and mental vigour, and instead of skilful craftsmen we shall breed incompetent machines." The address insists that either the school-leaving age must be raised or a system of part-time instruction during working hours of engineering apprentices must be introduced.

THE April issue of the Proceedings of the Institute of Chemistry contains the presidential address delivered by Sir James J. Dobbie on March 1. In it is discussed at length the question of the general education of chemists. Sir James defines the aim of education on its intellectual side as the evenly balanced training of all the faculties of the mind, and claims that this aim can never be attained by the study of science exclusively on one hand, or of the subjects commonly classed as the humanities on the other. At the same time, science must form part of every person's education. Dealing with the question what science subjects should be taught in schools, he lays it down that the one way to obtain satisfactory results is to concentrate on a limited number of subjects, carefully selected with reference to the pupil's age and stage of mental development and to their suitability to serve as an introduction to further science studies. He selects as most suitable subjects for study the facts and principles of biology and those of physics and chemistry as lying at the root of all the other sciences. The study of the properties of matter and of mechanics should, the address maintains, precede the study of the special branches of physics and the study of chemistry. Any scheme of science teaching would be unsatisfactory which does not make some provision for chemistry, and the study of chemistry should be taken next after mechanics. Work such as this should, Sir James Dobbie thinks, be supplemented by wide reading in other branches of science so as to widen the interests of the pupils and to extend their knowledge.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 17.—Dr. A. Smith Woodward, vice-president, in the chair.—E. **Heron-Allen**: The mussel-fishery and Foraminifera of Esnandes (La Rochelle), and the early work of Alcide d'Orbigny. A series of slides was exhibited illustrative of the early studies of Alcide d'Orbigny at Esnandes (near La Rochelle), and the mussel-fisheries established there since the year 1035 The experiments of Prof. W. A. Herdman on the west coast of England were referred to, and those of Prof. A. Meek at Holy Island on the east coast. A further series was shown illustrating some of the notable d'Orbignyan species found in the neighbourhood, not recorded from there by d'Orbigny in 1826, but recorded from other localities at that date, and from distant seas between 1839 and 1846. A third series of slides illustrated well-known species from the locality which had been recorded and described by earlier authors, but were not apparently identified by d'Orbigny from the neighbourhood of La Rochelle.

Linnean Society, April 19.—Sir David Prain, president, in the chair.—Dr. D. H. **Scott**: The Heterangiums of the British Coal Measures. Heterangium, Corda, is a genus of Carboniferous plants, based on specimens with the structure preserved, and now classed with the Pteridosperms. It is proposed to group *H. shorense*, *H. tiliaeoides*, and *H. Lomaxii* (of which *H. cylindricum* is only a form) in a new subgenus, Polyangium. It is probable that the Upper Coal Measure species from Autun described by Renault also fall under this subgenus, while most of the very interesting Silesian species, of Millstone Grit age, recently discovered by Dr. Kubart, appear to belong to the simpler type which may be called Euheterangium.—E. S. **Goodrich**: The development of Hatschek's pit and the ciliated organ on the roof of the buccal cavity in Amphioxus from the left anterior cœlomic sac and from an ectodermal preoral pit in the embryo and larva. Following Bateson, the author compared the opening of Hatschek's pit with the proboscis-pore of Balanoglossus and water-pore of Echinoderms.—Miss Nina F. **Layard**: Wooden scratching-tools made by an African parrot. Notes have been taken by the author of the behaviour of a grey African parrot, first in choosing out natural tools, such as pointed seeds and quills, for use as poll-scratchers, later in pointing up a match for the same purpose, and finally shaping up wood in such a way as to appear to warrant the bird's claim to be described as a tool-maker. The contention is that if it can be proved that the parrot, requiring an implement that would penetrate the feathers to the scalp, purposely produced a point with this object, then the border-line between the mere tool-user and the tool-maker has been crossed.

PARIS.

Academy of Sciences, April 10.—M. A. d'Arsonval in the chair.—H. Le **Chatelier**: The National Research Council in the United States.—P. **Puiseux** and B. **Jekhowsky**: Study on the general form of the lunar globe. The moon appears to be slightly elongated in the direction of its axis of rotation. A tetrahedral deformation cannot be regarded as definitely proved.—J. **Bergonié**: The superiority of agricultural work medically prescribed and controlled to the physical therapeutic treatment of the hospitals in the treatment of after effects of war wounds. The results of a practical comparison of the two methods taken over a period of thirty months prove the superiority of the open-air natural treatment to combinations of electrotherapy, mechanotherapy, thermotherapy, kinesitherapy, mechanical and manual massage, hydrotherapy, etc. The superiority is especially marked in the case of men employed on the land previous to the war. Even in non-agricultural workers the superiority, although less marked, is still considerable.—G. **Julia**: The reduction of forms to indeterminate, conjugated non-quadratic forms.—G. **Arnaud**: The family of the Microthyriaceæ.—A. F. **Legendre**: The structure of the Sino-Tibetan massif.

April 16.—M. A. d'Arsonval in the chair.—A. **Lacroix**: The haüyne lavas of the Auvergne and their homogeneous enclosures.—H. Le **Chatelier**: The synthesis of ammonia. The author gives extracts from his patent of September, 1901, for the synthetical preparation of ammonia from its elements, work taken up seven years later by Haber and now made use of on the large scale in Germany.—A. **Gautier**: Increase in the curative properties of quinine and of mercury by the organometallic compounds of arsenic. The joint administration of arrhenal and quinine chlorohydrate cures cases of malarial fever which have resisted large doses of quinine alone. The association of arsenical compounds with salts of mercury enables effective cures to be produced with much reduced doses of mercury, and cases of syphilis respond rapidly to this treatment.—E. **Ariès**: The coefficients of thermoelasticity at low temperatures and Nernst's hypothesis.—M. **Riquier**: A property of the analytical functions of any number whatever of imaginary variables.—M. **Mesnager**: The representation of concentrated charges by trigonometrical series.—C. E. **Guye** and C.

Stancescu: Explosive potential in carbon dioxide at high pressures. Experiments with carbon dioxide at pressures between five and forty-five atmospheres, and with striking distance between the plates (d) varying between 0·34 mm. and 2·24 mm., proved that the explosive potential $V=F(md)$, where m is the number of molecules in unit volume of gas.—**P. Woog** and **J. Sarriau**: A method of observation and measurement of rapidly periodic magnetic phenomena. An application of the Koenig manometric capsule.—**M. Trabut**: The hybrid origin of cultivated lucerne.—**A. Guilliermond**: The alterations and the characters of the chondriome in the epidermal cells of the tulip flower.

BOOKS RECEIVED.

The Secretion of Urine. By Prof. A. R. Cushny. Pp. xi+241. (London: Longmans and Co.) 9*s.* net.

The Borderlands of Science. By Dr. A. T. Schofield. Pp. viii+255. (London: Cassell and Co., Ltd.) 6*s.* net.

The Distribution of Attention. By E. N. McQueen. Pp. vi+142. (Cambridge: At the University Press.) 5*s.* net.

Electric and Magnetic Measurements. By C. M. Smith. Pp. xii+373. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

Science Française Scolastique Allemande. By Prof. G. Papillault. Pp. 154. (Paris: F. Alcan.) 2 fr. 50.

Theophrastus: Enquiry into Plants, and Minor Works on Odours and Weather Signs. With an English translation by Sir A. Hort. (Loeb Classical Library.) 2 vols. Vol. i., pp. xxviii+474; vol. ii., pp. ix+499. (London: W. Heinemann.) 5*s.* net each vol.

Stresses in Wire-wrapped Guns and in Gun Carriages. By Lt.-Col. C. d'H. Ruggles. Pp. xi+259. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s.* 6*d.* net.

The Chemistry of Dyestuffs. By M. Fort and Dr. L. L Lloyd. Pp. xi+311. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

The Mexican Indians North of Mexico. By W. H. Miner. Pp. xi+169. (Cambridge: At the University Press.) 3*s.* net.

Ethnobotany of the Tewa Indians. By W. W. Robbins, G. P. Harrington, and B. Freire-Marreco. Pp. xii+124. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.—Election of Fellows. At 4.30.—Croonian Lecture: The Excitation Wave in the Heart: Dr. Thomas Lewis.

ROYAL INSTITUTION, at 3.—Pagan Religion at the Time of Coming of Christianity: Prof. Gilbert Murray.

MATHEMATICAL SOCIETY at 5.30. Sir George Stokes and the Theory of Uniform Convergence: G. H. Hardy.—A Symmetrical Condition for n-Apolar Triads on a Cubic Curve: Dr. W. P. Milne

IRON AND STEEL INSTITUTE, at 10.30 a.m.—Steel Ingot Defects: J. N. Kilby.—Influence of Surface Tension on the Properties of Metals, especially of Iron and Steel: F. C. Thompson.

INSTITUTE OF METALS, at 8.30.—Seventh May Lecture: Researches made Possible by the Autographic Load-Extension Optical Indicator: Prof. W. E. Dalby.

LINNEAN SOCIETY, at 8.—A Monograph of the Genus Fumaria: H. W. Pugsley.—The Flowers of the Ma' ua, *Bassia latifolia*, Roxb.: G. M. Ryan.—An Autograph of Vice-Admiral Bligh (1754–1817): C. D. Sherborn.—Two Critical Plants of the Greek Flora: C. C. Lacaita.—(1) Paracubaris, a New Genus and Species of Terrestrial Isopoda from British Guiana; (2) The Oral Appendages of Certain Species of Marine Isopoda: Dr. W. E. Collinge.

CHEMICAL SOCIETY, at 8.—Researches on Asymmetric Nitrogen Compounds. I.: 5-Aminosalicylic Acid and Related Compounds; II: Some Nitrated Oxydiphenylamines; III.: Oxyphenylglycine: The late R. Meldola, H. S. Foster, and R. Brightman.—Contributions to the Chemistry of Caramel. I.: Caramelan: Miss M. Cunningham, and C. Doree.

FRIDAY, MAY 4.

ROYAL INSTITUTION, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

IRON AND STEEL INSTITUTE, at 10 a.m.—The Penetration of the Hardening Effect in Chromium and Copper Steels: L. Grenet.—Cementation by Gas under Pressure: F. C. Langenberg.—Origin and Development of the Railway Rail: G. P. Raidabaugh.—Case Hardening of Iron by Boron: N. Tschischewsky.—Determination of the Line S.E. in the Iron-Carbon Diagram by Etching Sections at High Temperatures *in vacuo*: N. Tschischewsky and N. Schulgin

GEOLOGISTS' ASSOCIATION, at 7.30.—The Correlation of the Ingletonian Slates: J. F. N. Green.—The Landslips of Folkestone Warren and the Thickness of the Lower Chalk and Gault near Dover: C. W. Osman.

SATURDAY, MAY 5.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

MONDAY, MAY 7.

VICTORIA INSTITUTE, at 4.30.—The Pre-requisites of a Christian Philosophy: Rev. Dr. Whately.

ARISTOTELIAN SOCIETY, at 8.—The Basis of Critical Realism: Prof. G. Dawes Hicks.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Race and Nationality: Dr. Marion Newbigin.

ROYAL SOCIETY OF ARTS, at 4.30—The National Shortage of Iron Ore Supplies II.: Oversea Iron Fields which Supply the British Market: Prof. W. G Fearnsides.

SOCIETY OF ENGINEERS, at 5.30.—The Goods Clearing House System Explained: Lord Headley.

TUESDAY, MAY 8.

ROYAL INSTITUTION, at 3.—Rhythmic Action in Muscle and in Nerve: Prof. C. S. Sherrington.

WEDNESDAY, MAY 9.

ROYAL SOCIETY OF ARTS, at 4.30.—Works Organisation and Efficiency: Prof. W. Ripper.

THURSDAY, MAY 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Permanent Periodicity in Sunspots: Sir Joseph Larmor and N. Yamaga.—The High-frequency Resistance of Multiply Stranded Insulated Wire: Prof G. W O Howe.

ROYAL INSTITUTION, at 3.—Pagan Religion at the Time of the Coming of Christianity: Prof. Gilbert Murray.

FRIDAY, MAY 11.

ROYAL INSTITUTION, at 5.30.—Radioactive Haloes: Prof. J. Joly.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MAY 12.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

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THURSDAY, MAY 10, 1917.

EDUCATIONAL IDEALS.

(1) *German and English Education: A Comparative Study.* By Dr. Fr. De Hovre. Pp. 108. (London: Constable and Co., Ltd., 1917.) Price 2*s.* 6*d.* net.

(2) *The Permanent Values in Education.* By Kenneth Richmond, with an Introduction by A. Clutton Brock. Pp. xxiii+136. (London: Constable and Co., Ltd., 1917.) Price 2*s.* 6*d.* net.

(1) THE first of the above volumes, by Dr. De Hovre, of the Higher Institute of Philosophy of the University of Louvain, is a lucid statement of what he believes to be the fundamental differences between the essential aims of German and of English education, and includes a particularly interesting discussion as to the genesis and real significance of the much debated term "Kultur." He finds its basis in nationalism—upon it, as the foundation-stone, the German Empire has been built—in an ultra-devotion to intellectualism divorced from morals, and in the adoption of the formula "Education to the State, for the State, by the State." "Kultur," he says, is the soul of Germany, "civilisation" the soul of England, and he seeks to establish his thesis by reference to the fruits of the respective policies and measures of the rival nations in the sphere of colonial enterprise, in trade, and in social and political life, to the great disadvantage of Germany. "Humanism," he declares, is the vital element in English education, whilst nationalism, intellectualism, militarism, are the three fundamental principles of German life and education, summed up in the comprehensive term "Kultur." In short, the aim of English education is to make "men" through the development of character, whilst that of German education is to make "Germans" subservient to the State in all the varied activities of life, with a view to the aggrandisement of Germany and the imposition of her learning, her discipline, and her organisation upon the rest of the world.

It is admitted that the English nation has not a strong belief in education, that what her education lacks is a wider horizon, a deepening of intellectual culture, and a more efficient organisation, though it is firmly rooted on the solid basis of the freedom of the individual soul and on the development of character as its chief purpose. To bring about these reforms constitutes a formidable task, but their accomplishment is essential to the well-being of the nation, and, if realised, will place England in the forefront of the civilised nations of the world.

The author expresses the opinion that the strength of English education lies in its fundamental principles, and its weakness in its superstructure, whereas the opposite is the case with Germany. It will be felt by many readers that a too favourable view is taken of the actual state of English education, and that German education has scarcely met with the full appreciation which its great achievements deserve.

(2) Mr. Richmond's book is devoted to a consideration of the ideals which have inspired the minds of some of the world's greatest educators, and is an eloquent exhortation to all those engaged in the work of education to seek refreshment in the thoughts and aspirations of the prophets and teachers of past times, in "the wide universalism of Comenius, the devoted humanitarianism of Pestalozzi, and in the practical idealism of Froebel," in the sure hope that they will not be disappointed. It is the aim of the author to consider these ideals in the light of present-day conditions and needs, and to recast them for its service. The Jewish and Greek ideals, the Roman and Medieval, and the Renaissance, together with the teachings of Milton, of Locke, of Rousseau, and of Herbart, are discussed with the view of bringing to light those elements which appear to be of permanent value. Referring to the controversy now recrudescent between the advocates of scientific and literary training, the author suggests a synthesis such as Bacon, or Comenius, or Herbart would have desired. Science is to-day an activity of far wider and more complex significance than ever it has been before, and, in view of the inevitable struggle that lies before us, must be accorded its rightful place throughout the entire sphere of educational organisation, nor must the teachings of a true patriotism be neglected, so as to bring about harmony not only between class and class, but between nation and nation.

GEOMETRY AND ANALYTICAL MECHANICS.

(1) *A Treatise on the Circle and the Sphere.* By Dr. J. L. Coolidge. Pp. 602. (Oxford: At the Clarendon Press, 1916.) Price 21*s.* net.

(2) *Exercices et Leçons de Mécanique Analytique.* By Prof. R. de Montessus. Pp. ii+334. (Paris: Gauthier-Villars et Cie, 1915.) Price 12 francs.

THE first of these is a work of great significance, by the author of the well-known "Non-Euclidean Geometry," for which English readers will be very grateful. Its title may perhaps mislead, for it is by no means an elementary book; indeed, anyone who reads it conscientiously and follows out its manifold implications will have traversed wide fields of modern geometry, dealing not only with circles and spheres, but with line geometry, with hypergeometry, with non-Euclidean geometry, and with the theory of continuous groups. The specifically English reader will probably find it a most interesting and stimulating exercise to translate many of the results of the latter portion of the book into the language of projective geometry, with which his training may have made him more familiar; and if he thinks that this is the form in which the theorems should be summarised, he will be no less grateful to the author for his presentment. The first three chapters (pp. 19–188) deal with the elementary plane geometry of the circle. Apparently every-

thing to which we are accustomed in this respect receives masterly treatment here; even the so-called modern geometry of the triangle is handled with a detail which to many readers will seem excessive. The author's notation for angles and segments is, however, in the reviewer's opinion, needlessly tiresome.

The sphere receives a similar elementary treatment of less extent in chaps. v. and vi. (pp. 226–82). Chap. iv., with the title, "On the Tetracyclic Plane," introduces a method of presentment, followed also from chap. vii. to the end, about which opinions may well differ. The book on the whole has such value that criticism is a form of praise, and we shall express our opinion freely. We think the author might have introduced his chapter on the tetracyclic plane, say, by a brief account of Clifford's projection of the plane sections of an ellipsoid from an umbilicus: when the plane of projection is the tangent plane at the opposite umbilicus, actual circles are obtained, and two of these cut at right angles when the corresponding plane sections of the ellipsoid are in conjugate planes. If this were too elementary, he could, even then without introducing the co-ordinates in the first paragraph have defined quasi-circles as projections on to an arbitrary plane of plane sections of a quadric taken from an arbitrary point of the quadric. This would give at once the geometrical meaning of the tetracyclic co-ordinates. The projection of the intersection of the fundamental quadric with another quadric is then obviously a quartic curve with two nodes; there seems no great gain in calling such a curve a cyclic. The tangent planes of the cones containing the curve of intersection of the two quadrics intersect the fundamental quadric in curves projecting into the four systems of generating circles of the cyclic, and it is easily seen that the centres of the circles of one generation lie on a conic. All this seems clearer without the co-ordinates. And it is curious that a writer on non-Euclidean geometry should not recognise that the admirable theorem quoted from Jessop (p. 212), in regard to the angles between generating circles of different generations, is a generalisation of an old friend, relating to the difference of the distances of a variable point of the focal hyperbola of a system of confocal quadrics from two fixed points of the focal ellipse, the absolute being one of the confocal quadrics.

Similar remarks apply to chap. vii., on pentaspherical space, and chap. xiii., on circles in space; we think the projective geometry, of which these are translations, should be brought forward first and made more fundamental. The reader, after he has had the pleasure of turning the author's theorems back into projective geometry, will, we think, summarise them as such. The author recognises that the famous pentacycle of Stephanos is no more than a nearly obvious theorem for lines in four dimensions; he refers to Segre's cubic variety in four dimensions (p. 506), and there may be a real gain in calling it a cubic complex of spheres. It certainly is very interesting to have the theorems for spheres which he states; but we think a greater insistence on the projective geometry should have preceded his treatment, especially as a large part of the theory can be obtained without the explicit use of co-ordinates.

Some minor remarks may be added. There are occasional misprints; on p. 284 there are three (lines 1, 5, and 15 from the bottom.) The definitions of the many technical terms are not given sufficient prominence; if one forgets the meaning of such a term, it is in some cases a matter of hunting to find it again. On p. 351 the author refers to his impression that Cayley spoke of the sign of the radius of a circle; one place where this is so at least is in the "Collected Papers," vol. ii., p. 140. The reference to Weitzenböck in the footnote on p. 485 is obscure; the p. 2574 refers to the *Wiener Sitzungsberichte* referred to in the footnote on p. 484.

To use a phrase often employed by the author, these minute criticisms, it is seen, are not transfinite in number. Copying again the concluding phrase of what is a very gracious preface, which all Englishmen will be glad to read, the reviewer would like his last word, as was his first, to be one of gratitude to the author. His book is a noble addition to the geometrical literature in the English language, and must have a great influence on the prosecution of the study in all countries where English is read.

(2) This is a collection of elementary examples, in which the details of calculation are given at length, for the most part solved by Lagrange's equations. Pp. 1–109 are occupied with computations of centres of gravity, attractions and potential, and moments of inertia. Then one page is given to expounding the principle of virtual work, and one to D'Alembert's principle; after this the equations of Lagrange are briefly obtained. Chap. v. (p. 121) begins with an example discussing the motion of a sphere on the surface of a smooth cylinder (not in two dimensions), in which it is assumed, without previous discussion, that the motion of the centre is independent of rotation. Pp. 262–323 are occupied with an arithmetical discussion of the introductory formulæ of the theory of elliptic functions, but without any application to statical or dynamical problems. Throughout the volume the computations are arranged in a brief, businesslike way, and the diagrams are clear and numerous. As a working class-book, in the hands of a competent teacher concerned mainly in teaching the art of solving concrete examples, the book might be of great use.

A TEXT-BOOK OF GENETICS.

Genetics and Eugenics: A Text-book for Students of Biology and a Reference Book for Animal and Plant Breeders. By Prof. W. E. Castle. Pp. vi+353. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1916.) Price 2 dollars net.

SINCE the beginning of the present century, when genetic research passed from the province of the amateur to that of the professional,

Prof. Castle has been recognised as one of the most active workers on these lines. A book embodying his outlook after years of teaching and research is sure of a welcome from all who are interested in these matters. The volume is evidently designed more especially for the university student. It falls roughly into three sections: an introductory portion dealing with theories of evolution and what may be termed pre-Mendelian genetics, a main part treating of contemporary genetic work, and a final section on human heredity and eugenics. The amount of ground covered involves a condensed treatment of many important questions, and though this need not be a drawback to the student whose reading is supplemented by lectures, it makes it rather a difficult book for the average reader.

The author has approached the subject almost entirely from the zoological side, and, for a book of the sort, devotes an unusual amount of space to the inheritance of characters in domesticated animals. This part of the work is freely illustrated by photographs which have generally been well reproduced. But in some cases, as in Fig. 53, an attempt has been made to indicate colour differences in black and white, and the result is not happy.

Though the space devoted to plants is avowedly brief, the omission of any adequate account of the remarkable phenomena exhibited by plant chimæras must be regarded as a shortcoming, for it may well be that the principles here involved will turn out eventually to be of much wider application than appears at present. Some of the statements in this section are open to criticism by the botanist, as, for example, that which records doubling in the poppy as recessive to single. The reverse is true of Meconopsis.

In connection with sex-determination more attention might have been paid to the phenomena associated with gynandromorphs. The extraordinarily interesting and suggestive work of Goldschmidt is not even mentioned.

The best part of the book is that dealing with the effect of selection and the constancy of hereditary factors. From extensive experiments on the inheritance of white markings in rats, Prof. Castle has come to the conclusion that the hereditary factors upon which pattern depends may undergo alteration on crossing, thereby becoming either more or less potent in bringing about their peculiar reaction. *Plus* and *minus* variants are thus produced which may be isolated by selection. He speaks of the process as one of "contamination," though it is not altogether clear how he supposes it to be brought about. His ideas have been subjected to severe criticism in America, where many geneticists prefer to explain these phenomena on the hypothesis of multiple factors or of specific modifiers. It is clear that we do not yet understand this type of inheritance, and Prof. Castle's presentation of his case deserves most careful consideration.

The treatment of eugenics is eminently sane, and most people will probably agree with the conclusion that "we should extend our knowledge as rapidly as possible, but not legislate until we are very sure of our ground."

An excellent feature is an appendix containing a translation of Mendel's paper, which ought to be carefully digested by every student. A fairly full bibliography concludes the work. This might well be revised in a later edition to include all references to papers mentioned in the text. On p. 208 alone, for example, there are three such references which are not to be found in the bibliography.

OUR BOOKSHELF.

Life and Habit. By Samuel Butler. New edition, with author's addenda. Pp. x+310. (London: A. C. Fifield, 1917.) Price 5s. net.

We were a little afraid to read "Life and Habit" again after a quarter of a century, lest all the magic might have gone. Perhaps some of it has, for we found tediousness in the criticisms of Darwin—*e.g.* in that culminating on p. 260 with the conclusion that a certain sentence from the "Origin of Species" "does not contain, or at any rate convey, any clear or definite idea at all." Butler was sometimes too much preoccupied with his own views; in this case the meaning of Darwin's sentence seems no conundrum. But the old charm is still in the book—the good humour, the epigrams, the dividing sword, the sincerity, the insight. The new edition seems to differ from that of 1877 only in including four short addenda found among the author's papers. The first and second are biologically interesting; the fourth strikes one as a lapse of good taste which should have been left to blush unseen.

That Butler's genius gave him insight into evolution problems has been generally, though tardily, recognised. What were the convictions that led him to react so violently from Darwinism? The first was that "there is in every impregnate ovum a *bonâ-fide* memory," more than a system of characteristic chemical processes occurring in a characteristic colloidal substratum. By memory he did not mean necessarily conscious memory. The second was that he could not bring himself to believe that the raw materials of evolution, variations to wit, arose by chance, "blind" and "unintelligent." The third was that when a living creature does something often, the frequently repeated experience must affect the germ-cells and have results enregistered in them. It is strange that so ingenious a mind never really understood the subtlety of natural selection, the way in which it sifts directively, not randomly, its consistent reference to the established web of life, and its progressive character. J. A. T.

Compressed Air Practice in Mining. By David Penman. Pp. vii+221. (London: Charles Griffin and Co., Ltd., 1916.) Price 5s. net.

The first two chapters of this book, dealing with the theory of air compression and subsequent ex-

pansion, together with the efficiencies of each conversion of energy, are very good, as is also the short third chapter on indicator diagrams. In the fourth chapter, on air-compressors, exception may perhaps be taken that reciprocating air-compressors have been described under the names of firms which make them, rather than under headings derived from differences of design, though, otherwise, the description of these compressors is good, as is also that of the turbo-compressors in chap. v. In the sixth chapter, devoted to the transmission of compressed air, there is but little discussion of the principles of loss of pressure by friction, the author in this matter relying on Peele's well-known book. Coming, in the eighth chapter, to the machines making use of compressed air, coal-cutting machines first receive attention, and the principal machines employed in Great Britain are described. The description of rock-drills in chap. x. is accomplished chiefly under the names of firms making these drills, which is not an interesting procedure from a technical point of view. Mention is made of the use of compressed air in haulage and conveying, while in the twelfth and final chapter the transmission of power by compressed air is compared with that by electricity. In this it is stated that the cost of generating compressed air compares favourably with that of generating electricity, a statement with which few will agree.

The book in its later parts is disappointing and does not bear out the promise of its early chapters, so that, altogether, it does not do justice to its title. Within these limitations, it is, however, clearly written, while the assistance in elucidation which a number of worked problems give is a commendable feature.

Bill's School and Mine. A Collection of Essays on Education. By W. S. Franklin. Second edition. Pp. 102. (South Bethlehem, Pennsylvania: Franklin, MacNutt, and Charles, 1917.) Price 1 dollar.

THE new edition of Prof. Franklin's brightly written essays, with their advocacy of education in the "Land of Out-of-Doors" and of the claims of sensible science to a prominent place in school curricula, is enriched by a new essay on "Education after the War." In this paper he deals effectively with the unfriendliness towards science teaching prevalent in certain influential circles. Science, he urges, is finding out and learning how, whereas most people think of it only in terms of its material results. To quote Prof. Franklin: "It is now as much a mistake to oppose the fullest and widest possible development of Finding Out and Learning How as it was years ago to oppose labour-saving machinery; only it is quite necessary to make readjustments for the conservation of character and morals—and physique! Indeed, this necessity has shown itself most distinctly in our reluctance to make just such readjustments among those whose labour has been so wonderfully 'saved' by machinery!"

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Flat-foot in Young Women.

THIS deformity is exceedingly common among the young women of our nation, and it is not for lack of opportunity that it is studied so little. The present fashion of short skirts presents to us now an exceptional chance of finding out the extent of this evil. If the short skirt be destined to be permanent, it will be unique among the numerous fashions of women. The chance is here and now, and may not return.

Among certain negro races flat-foot appears to be normal, and in them perhaps it is an adaptation and a feature of their evolution. It is not so among us, and cannot be classed among the variations which are studied by biometricians.

Impressed by the sight of so many flat feet which young women are exhibiting below their short skirts, I made an observation of 355 persons of about the age of fifteen to forty-five, and noted the proportion of flat feet to normal ankles and feet, and I found 251 with definite signs of this defect. This represents a serious disability in this group for active life in the strenuous days to come, all the more because the persons noted belonged to the more favoured classes, living in a large and prosperous town. In addition to these, I noted about 200 more cases, which can only be classed as "borderland cases," and further investigation convinces me that there are more than 70 per cent. of our younger women and girls thus hindered from full locomotive and mental activity.

There are two main reasons why this deformity is important—first, that it is ugly and produces an ungainly gait; secondly, that walking and standing are rendered painful by it, and therefore unduly exhausting to the nervous system. I venture to say that if the attention of Mr. Fisher and the Board of Education were directed to Prof. Keith's valuable booklet, "The Human Body," they would not be long in doubt that flat-foot in girls is a pressing matter for them to consider, while they can. Prof. Keith points out that in all joints, except the knee-joint, the bones are kept in apposition by muscles and not by ligaments, that the arch of the foot is maintained by the steady and continuous reflex action of muscles, that the act of standing is an extremely complex act involving many muscles, and that all the time messages are passing from these to the centres in the spinal cord, from which other messages are being issued to co-ordinate the muscles in their action—a state of things well calculated to add much to the exhaustion of nervous centres when carried on with broken-down arches of the feet.

The series of cases I have described here is too small for any generalisation, but it is worthy of the notice of education authorities and their expert advisers. It is not a matter for investigation only by medical men. They are chiefly called upon to treat the deformity when it has come to a painful and gross form, and the clinical method of examination, with the foot raised, or even observation of the bare foot in standing, is not enough for the discovery of the slighter degrees of it. It needs to be observed from behind when the person is walking, so that the full degree of *working defect* may be known.

I submit that this is a matter for early attention, and for a system of remedial foot-drill in schools for our growing children. M.D., F.R.S.E.

May 1.

Classical Education and Modern Needs.

A REVIEW by Mr. H. G. Wells in NATURE of April 19 contains the following words: "This claim is pressed even more impudently by Mr. Livingstone in his recent 'Defence of Classical Education.' He insists that all our sons are to be muddled about with by the teachers of Greek up to at least the opening of the university stage."

This is a complete misrepresentation of my views, the more gratuitous because in several passages I insist on the importance of *not* teaching Greek and Latin to those boys who are unsuited for them—*e.g.* on p. 241: "It ought to be a first aim . . . to avoid diverting boys with mechanical or scientific tastes, who have no aptitude for linguistics, into studies that will be barren for them." (The context shows that the studies referred to are Latin and Greek.)

With regard to the present system of "compulsory Greek," after pointing out that it was an undesirable system, maintained on the ground that without it Greek teaching would, in present circumstances, disappear in many important educational areas, I remarked that "it would be possible, almost without opposition," to abolish it if such facilities were provided for the study of Greek as would put it within the reach of all boys in secondary schools *who wished to learn it.* This does not seem to me an impudent claim; it would be easy to satisfy; and I imagine that no one would take exception to it.

R. W. LIVINGSTONE.

Corpus Christi College, Oxford,
April 23.

MR. LIVINGSTONE'S letter is satisfactory, so far as it goes, in promising to spare such boys as are unworthy of classical blessings, but I think many of the readers of NATURE will see in its phrasing just that implicit claim to monopolise the best of the boys for the classical side of which I complain. We do not want the imbeciles, the calculating boys, the creatures all hands and no head, and so forth, for the modern side. We want boys for scientific work who may be not "unsuited," but eminently suited for Greek and Latin, in order that they may do something better and more important. I write with some personal experience in this matter. I am very much concerned in the welfare of two boys who have a great "aptitude for linguistics," and would make excellent classical scholars. I think I can do better with them than that, and that they can serve the world better with a different education. In each case I have had to interfere because they were being "muddled about with" by the classical side masters, and have got Russian substituted for the futile beginnings of Greek. The fact remains that Mr. Livingstone does, under existing conditions, wish to retain compulsory Greek.

H. G. WELLS.

The Frequency of Snow in London.

IN NATURE of May 3 Mr. L. C. W. Bonacina directs attention to the number of days on which snow was observed respectively at Wandsworth Common and in the neighbourhood of Hampstead during the early months of 1917. Incidentally he expresses some doubt as to the accuracy of the Wandsworth Common observations.

That it is possible for considerable variations in weather to exist over the hundred square miles or so of territory comprised within the metropolitan area is a fact I had hitherto regarded as within the limits of common knowledge. The variations observed during the recent winter months are clearly indicated in the following table, which has been compiled mainly from information given in the Monthly Weather Report of the Meteorological Office. The table shows for eight stations situated in and around London the number of days upon which snow or sleet was observed during each of the five months November, 1916, to March, 1917. The results for April are not yet available. For purposes of comparison I have also inserted in the table the records made at Wandsworth Common and at Mr. Bonacina's station, which may, I suppose, be assumed to be at Parliament Hill. Mean results for the whole of the ten stations are given at the foot of the table.

Days with Snow or Sleet, November, 1916–March, 1917.

Station	Nov.	Dec.	Jan.	Feb.	March	Total for the 5 months
Camden Square ...	1	3	7	3	13	27
Enfield	1	3	10	3	8	25
Greenwich (Royal Observatory) ...	1	5	16	5	12	39
Hampstead (Parliament Hill) ...	1	3	20	4	11	39
Hampstead (Reservoir)	3	7	19	6	13	48
Richmond (Kew Observatory) ...	2	3	15	4	10	34
South Kensington (Meteorological Office)	1	2	10	5	5	23
Tottenham	1	1	7	3	7	19
Wandsworth Common	2	3	11	3	10	29
Westminster ...	2	2	14	3	14	35
Mean of the ten stations	1·5	3·2	12·9	3·9	10·3	31·8

The table shows, in the first place, that the number of days upon which snow was observed at Wandsworth Common was in fair accordance with the mean results for the whole of the ten London stations. The total number in the five months was, it is true, somewhat smaller, but was at the same time in excess of that recorded at four of the ten stations, viz. Camden Square, Enfield, South Kensington, and Tottenham. The greatest divergence between the Wandsworth Common and the mean results was in January. The number of days with snow was then much smaller than at the two Hampstead stations, and was appreciably smaller than at Greenwich, Richmond, or Westminster. It was, however, larger than at the other four stations already quoted, so that if we begin to doubt the accuracy of the Wandsworth Common observations we must not stop there. We must question also the records made at important official stations, such as Camden Square and South Kensington.

The local variations which may exist in regard to such an element as snow (much of which came last winter in the form of fleeting showers) is clearly shown by the fact that while the total number of falls at Parliament Hill in the five months agreed precisely with the Greenwich record, it was appreciably smaller than at Hampstead Reservoir, little more than a stone's-throw away. FREDK. J. BRODIE.

30 Loxley Road, Wandsworth Common, S.W.

With reference to the recent correspondence in the columns of Nature upon the frequency of snowfall in London during the past winter, it may be of interest to state that at the Hampstead Scientific Society's observatory at the extreme summit of Hampstead Heath (453 ft.) some form of snow or sleet was recorded on as many as sixty-one days, nineteen of these being in January, and thirteen both in March and in April.

In this country most of our snow comes with winds from N. and N.E., and hence it need scarcely seem a matter for wonder that a place, such as Hampstead, situated to the north of the artificially heated metropolitan zone, should sometimes receive in the form of snow or sleet precipitation which reaches the southern suburbs as rain. Apart from the difference in height, the heating of the north or north-east current in its traverse over the city would account for the discrepancy mentioned by Mr. Bonacina.

This is, to my mind, a more probable explanation than that the observer at Wandsworth Common, who has assisted with distinction in the upbringing of modern meteorology almost since its birth, could fail to recognise snow or sleet, in whatever form it may have fallen.

E. L. Hawke.

May 5.

A Canvas-attacking Fungus.

So many inquiries have been made from strangely diverse sources, especially since the outbreak of war, concerning black spots which appear on bell-tents, sails, aeroplane and airship fabrics, etc., that it seemed desirable to write the present note principally to direct attention to a paper by F. Guéguen in *Comptes rendus*, vol. clix. (1914), p. 781, "Sur l'altération dite 'piqûre' des toiles de tente et des toiles à voile." The spots are caused by fungi which damage the fabric, so that after some months it is easily torn. The fungus hyphæ grow on the surface of the fabric, between the fibres and within the lumen of the fibres. Guéguen found that the fungi principally concerned were the Pyrenomycetes, *Pleospora infectoria* and *P. herbarum*, especially the former. These Ascomycetes are also found in their conidial states, *Alternaria tenuis* and *Macrosporium commune*, and other Mucedineæ, Rhinocladium, Helminthosporium, etc., are often associated with them. According to Guéguen, the malady is scarcely ever due to accidental contamination, but is caused by the development, in moist warmth, of moulds already present in the newly manufactured fabric, commercial patterns of the most diverse origin being found almost all to contain fungus spores. Practically all unbleached canvas is affected, but that bleached with hypochlorites, etc., remains free—the glaucous colonies which are sometimes seen are due to Penicillium or Aspergillus derived from the air, and almost invariably non-injurious to the fabric. Guéguen holds that the fungi causing the spots are those which grow on the dead stems of the textile plant, which are introduced amongst the fibres at the time of retting. The thick-walled hyphæ remain in a resting state in the dry canvas, and resume vegetative growth when external conditions become again favourable (humidity, warm confined air). He considers that the best method of prevention would be to sterilise the tow after retting, by heat—steam under pressure, and then dry heat. Boiling solutions of salts of chromium or copper would also serve, applied either to the tow or the fabric. A suitable method of rendering awnings, etc., impermeable would be to immerse the fabric first in a 20 per cent. solution of soap, and then in 8 per cent. copper sulphate, each at boiling point.

Similar black spots are very common on paper, and are most commonly due to Alternaria, Stachybotrys, and Chætomium. Sée ("Sur les moisissures causant l'altération du papier," *Comptes rendus*, vol. clxiv. [1917], p. 230) has investigated the variously coloured spots damaging paper, and believes that the causative fungi are already present in the paper-pulp, and probably come from the straw, fibre, etc., from which the pulp is made.

In the damaged fabrics examined by the writer the perfect Pleospora stage has rarely been found, though the Alternaria and Macrosporium conditions have been frequent. Other Mucedineæ, Cladosporium spp., Stachybotrys, Helminthosporium, etc., were also common. In certain cases fungi were found, however, which seem to be identical with species which are known to occur in the soil. A large number of fungi are active cellulose destroyers; many of these occur only in the soil, and it seems probable that a large proportion, if not most, of the cellulose destruction which goes on there is brought about by their agency. Canvas left lying about on broken ground would be almost certainly attacked by these cellulose fermenters, given the suitable conditions for growth—a very small portion of soil scattered over moistened sterilised filter-paper gives rise to an amazing number of fungus colonies. Although no experiments have yet been undertaken in connection with this suggestion, it is put forward for certain more or less obvious reasons.

J. Ramsbottom.

Department of Botany, British Museum (Nat. Hist.), London, S.W.

Diffraction Phenomena in the Testing of Optical Surfaces.

In the *Philosophical Magazine* for February, 1917, Lord Rayleigh has published an investigation of the phenomena to be expected according to the wave theory when an optical surface is tested at the focal plane by the well-known method due to Foucault, and has shown that, even when nearly the whole of the light is cut off by the advancing edge in the focal plane, the boundaries of the aperture retain a very marked brilliancy *which is symmetrical about the centre*.

An interesting question arises as to the manner in which this effect (which has been shown by Lord Rayleigh to be due to diffraction) would be modified if the light is screened, not exactly at the focal plane, but a little in front of, or behind, the focus. On testing this at this laboratory it has been found that the Rayleigh effect is still observed, but *the edges of the aperture on either side differ very markedly in their brilliancy*, one of the edges becoming several times brighter than the other as the screen is removed further and further from the focus. The explanation of this asymmetry is apparently the fact that, as we move away from the focus, the diffraction-pattern which is screened gradually passes from the Fraunhofer to the Fresnel class. Several series of photometric comparisons of the brightness of the two edges have been made at this laboratory, using a special type of rotating sector photometer devised by C. V. Raman (*Phil. Mag.*, May, 1911) and constructed by Hilger.

The full mathematical treatment of the subject and the detailed comparisons with the experimental results will be published in due course.

S. K. Banerji.

Indian Association for the Cultivation of Science, Calcutta, March 15.

THE RAMSAY MEMORIAL FUND.

AT the request of numerous friends and admirers of the late Sir William Ramsay a public meeting was held last October at University College, London, to consider the best means of establishing a memorial to him. The meeting was attended by representatives of H.M. Government, of the Allied and neutral Powers, and of the principal scientific societies of the United Kingdom. It was resolved, on the motion of the Rt. Hon. Lord Gainford, with the support of Sir J. J. Thomson, his Excellency the Belgian Minister, and Mr. W. H. Buckler, of the American Embassy, that a fund should be raised as a memorial to Sir William Ramsay, and that such a fund should be utilised for promoting chemical teaching and research under a scheme to be approved by the subscribers.

Since then the organisation of the appeal has been set up and is now complete. The Rt. Hon. H. H. Asquith has consented to act as president of the fund, whilst the vice-presidents include the Ambassadors and Ministers of Allied and neutral Powers, the Rt. Hon. D. Lloyd George, the President of the Board of Education, the President of the Royal Society, the Chancellors of the Universities of Cambridge, Glasgow, and London, the Rt. Hon. Lord Gainford of Headlam, and the chairman of University College Committee. The general committee, consisting of the subscribers, is under the chairmanship of the Rt. Hon. Lord Rayleigh. The Rt. Hon. Lord Glenconner and Prof. J. N. Collie share the office of honorary treasurer, and Dr. Smiles is acting as honorary secretary.

An executive committee, formed under the chairmanship of Sir Hugh Bell, has drawn up an appeal, which is at present only privately issued, but will shortly be circulated publicly. The committee aims at obtaining a sum of 100,000*l.*, and whilst the final form to be taken by the memorial will be submitted to the subscribers, and will necessarily depend on the amount obtained, the objects recommended are: (1) The provision of Ramsay Research Fellowships, tenable wherever the necessary equipment may be found; and (2) the establishment of a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London, where Sir William Ramsay's most important discoveries were made during his twenty-six years' tenure of the chair of chemistry. The committee has also in mind the inclusion of other forms of memorial, such as the institution of a Ramsay Medal for Chemical Research.

The committee considers that the conditions governing the award and tenure of the fellowships should be as elastic as possible. It is proposed that fellows should devote their time to investigating either chemical or chemico-technological problems, and, since it is further suggested that the fellowships should be tenable in any suitable place possessed of adequate equipment, it is evident that the scheme would permit fellows to carry out their researches in the laboratories of works. Also, in the second proposal the committee shows its sense of the necessity of meeting the demands of chemical industry. Being deeply impressed with the importance of providing for further teaching in relation to chemical and metallurgical industry, it proposes to provide for young chemists who intend to enter an industrial career a means of obtaining adequate training in the application of engineering principles to chemistry on a commercial scale. It is hoped that the establishment of a school of engineering chemistry in connection with a university will not only be to the mutual benefit of chemical industry and the chemists in its service, but will also promote the closer relations between industry and the schools of chemistry. In view of the importance of these objects, the committee is confident that the amount necessary to carry its proposals into effect will be obtained.

The sum already obtained by the private efforts of Sir William Ramsay's friends and from their own generosity amounts to about 13,500*l.* This includes the munificent donation of 5000*l.* from Messrs. Brunner, Mond, Ltd.; 1000*l.* each from the Rt. Hon. Lord Glenconner, Sir Hugh Bell, Sir Ralph C. Forster, Sir Robert Hadfield, Mr. Robert Mond, and Mr. Hugh Brunel Noble; and 500*l.* each from the president of the British Science Guild and Miss Lilias Noble.

INDUSTRIAL RESEARCH IN CANADA.

THE subject of industrial research in Canada is discussed in an interesting manner by Prof. J. C. McLennan, of Toronto University, in a presidential address to the members of the Royal Canadian Institute. In the address, publicity is given to several striking examples of the general indifference to scientific research, and among them is one which shows that Canada has not been in advance of the Mother Country in this respect. A department of the Government got interested in some way in the possible discovery of radium-bearing minerals in Canada, but the steps these officials took to find them showed that they were in complete ignorance of the work that had been done in their own universities in connection with radio-activity, although this work had gained for its authors a world-wide reputation in scientific circles.

Prof. McLennan makes a strong plea for the conservation and development of the natural resources of Canada. He tells us that a large percentage of the electrical power produced on the Canadian side of the Niagara River is being used to further the industries of their neighbours on the south, and he pleads for more energy and enterprise in the use of electrical power on the Canadian side. It is gratifying to learn that he is pleased with the work of Government departments in promoting the agricultural prosperity of Canada, but he thinks that much remains to be done in applying electrical power to agriculture, in the more extensive use of fertilisers, in ameli-

orating the conditions of farm life, improving roads, and increasing the facilities for education. Prof. McLennan discusses at length the methods that may be used to apply scientific research to Canadian industries. We gather from his remarks that the difficulties which have to be overcome in Canada are to a large extent the same as in the United Kingdom. It will be necessary for the firms in each industry to combine for purposes of research, and Prof. McLennan thinks that this will lead to the creation of great trusts, as in the United States, a result which, in his opinion, need not be an economic evil if due precautions are taken for the protection of the interests of labour and of the consumer. It scarcely follows, we think, that co-operation in research need lead to the formation of trusts. If the research work undertaken in common does not deal with matters of detail, the firms can surely retain their individuality and supplement the State-aided research by good scientific organisation of their own.

An important point discussed in the address is the part that the universities can take in industrial research. Prof. McLennan is anxious to see the universities take a prominent place in the work, but he expresses a strong opinion that research work of a secret nature or for the advantage of individual firms should not be encouraged in university laboratories. Nothing must be allowed to interfere with the training of the research worker in the university.

In addition to the university laboratories and those established for research in connection with special industries, the author points out the need for others in which work of a testing and standardising type would be done. He also thinks that the Royal Canadian Institute might find a special field of useful work if it aimed at providing laboratories of the type found at the Mellon Institute at Pittsburgh, where individual manufacturers could have problems of a private and exclusive nature dealt with at their own cost.

Prof. McLennan touches on such subjects as banking, protection, and housing problems. He tells us that it is comparatively easy in Canada for railroads, electric development companies, steel corporations, milling and other large and politically powerful interests to have very large advances made to them by the banks under legislative or Governmental guarantees, but it is not easy for certain vital or "key" industries to get the support they need. He agrees that the policy of Protection is both desirable and necessary, but he wishes to see it applied first of all to those industries which are basic and of vital importance to the community rather than to those, for example, which have to do with the preparation of foodstuffs and clothing. He thinks the time has come for a scientific revision of Canadian tariffs. He looks forward to the development of western Ontario, and especially the Niagara peninsula, into a region of great industrial activity, and he pleads that care be taken in advance to avoid in this district the wretched housing conditions which prevail in some manufacturing centres in the Old Country.

The June, 1916, issue of the Journal of the British Science Guild contains a report by Prof. Barnes, of McGill University, on the work of the Canadian Branch of the Guild. It is clear from this report that the Guild has taken a leading part in Canada, as at home, in concentrating attention on the necessity of organising scientific and industrial research, and the Canadian Government has now taken up the work on lines somewhat similar to those adopted by the Home Government.

Among the subjects considered by the Canadian Branch of the British Science Guild is that of science teaching in schools, and opinion appears to be divided on the relative values of physics, chemistry, and botany as school subjects. The present writer has long held the opinion that we should not teach in our schools courses of physics, chemistry, and so on, but that we should endeavour to frame a single course in science suitable for school work. The course should be selected so as to provide a due amount of experimental work and theoretical reasoning, and should include fundamental principles required for the further study of any branch of science. When we try to teach separate sciences in schools the result invariably is that the courses deal with subjects which do not interest schoolboys and are not of fundamental importance.

THE CULTIVATION OF MEDICINAL HERBS.

THE National Herb Federation, which has taken an active part in stimulating the collection and cultivation of medicinal herbs in this country, has issued a review of an article that recently appeared in the *Journal of the Board of Agriculture* under the above title. From this review it appears that the Board of Agriculture, which, in its leaflet published in October, 1914, and in a revised form in June, 1916, encouraged the production of a number of medicinal herbs, now makes the statement, based apparently on a communication from the National Health Insurance Commission (England), that the home demand for "drug-yielding herbs," with the exception of four essential species (belladonna, henbane, digitalis, and colchicum), is now met, and that the four essentials are likely to be put upon the market in sufficient quantity to meet all home demands.

The National Herb Federation very pertinently points out that, in addition to the home consumption of the medical profession, the home consumption of the drug factories, where preparations of the herbs are made in large quantities for exportation, has to be considered, and that the Imperial aspect of the question has apparently been jettisoned. The origin of the movement for the cultivation of medicinal herbs in this country was twofold, viz. (1) an attempt to meet the serious shortage due to the cessation of importation, and (2) an attempt to wrest from Central Europe an industry which we are capable of conducting. The general position appears to

be (*a*) that certain drugs must be considered as of primary importance and be cultivated irrespective of market conditions; (*b*) that with adequate encouragement a herb industry could be created that would exclude the importation of many foreign medicinal herbs; and (*c*) that, with the exception possibly of digitalis and male fern, cultivation is the only method by which this can be ensured.

There is much to be said for the patriotic attitude of the National Herb Federation and for the efforts it is making to establish a home industry on a sound basis.

PROF. H. F. E. JUNGERSEN.

By the death of Prof. Jungersen, Copenhagen has lost an outstanding citizen—both physically and mentally. Of a commanding figure and fine presence, he was a marked man at scientific gatherings at home and abroad, whilst his genial and courteous bearing, as well as his knowledge of English, made him especially welcome on this side of the North Sea.

Born in 1854, at Dejbjerg, in Jutland, son of Dean Jungersen, Prof. Jungersen received his early education at Odense, thence proceeding to the University of Copenhagen, where he graduated as M.Sc. in 1877, Ph.D. in 1889, and afterwards D.Sc. Throughout his career he was deeply interested in the fauna of Greenland, and he utilised his experiences in drawing up (1886, 1898, and 1904) accounts of the Danish expeditions. Though not a voluminous author, his researches on the Alcyonaria, Antipatharia, and Madreporaria of Greenland and the northern regions are important, and show scrupulous care in references to the literature as well as the synonymy of the subject. His memoir on the structure and evolution of *Pennatula phosphorea* in the *Zeitschrift f. wiss. Zool.* is also a noteworthy contribution; and still more his fascicle on the Pennatulidæ brought home by the *Ingolf* expedition, that of the *Diana* in Iceland and the Faröe Islands, the Norwegian expeditions, and the productive voyages of Dr. Joh. Schmidt in the *Thor*. His wide grasp of the subject and his sound judgment are conspicuous in this careful memoir, which is finely illustrated, and it is of special importance from the extensive sea-territory it comprehended, viz. the polar sea between Europe and Iceland, the sea to the west of Greenland, the northern part of the Atlantic down to 55° lat. N., and to the meridian off Cape Farewell. Another interesting contribution was that on the development of the sexual organs in the Teleosteans, and others on Ichthyotomy.

Prof. Jungersen visited this country several times, and on the occasion of the meeting of the British Association in Dundee in September, 1912, the University of St. Andrews conferred on him the honorary degree of LL.D. He was also a fellow of the Danish Royal Academy, president of the Natural History Society of Copenhagen, professor of zoology and director of the Zoological Museum in the University of Copenhagen, and a member of other Danish and foreign societies. His latest work was connected with the publication of the results of the *Ingolf* expedition, and his death at the comparatively early age of sixty-three will be regretted by all interested in this task, as well as for the loss to zoology in general.

In conclusion, if one observation of Prof. Jungersen is more important than another, it is his pointing out the difference between the deep-sea faunas north and south of the submarine ridges between Greenland, Iceland, the Faröes, and the Hebrides, a result due to the Danish *Ingolf* expedition.

W. C. M.

SIR ARMAND RUFFER, C.M.G.

The tragic death of Sir Marc Armand Ruffer will awaken, in the minds of many of his contemporaries, memories of the early struggles for the establishment of an Institute of Preventive Medicine in this country. It was largely due to Sir Armand Ruffer's efforts that the British Institute of Preventive Medicine, which has now grown into the Lister Institute, was founded and started in a small way in Great Russell Street in 1893. As its first director, he gave all his energy to its proper establishment on the lines of the Pasteur Institute, where he had previously worked with Pasteur and Metchnikoff, both of whom valued him very highly. In carrying out the first important work done at the new institute, namely, the production of diphtheria antitoxin, he contracted diphtheria and nearly lost his life. His health was so shattered by this very severe attack that he had eventually to relinquish the post of director, and went for a change to Egypt. After a rest he decided to settle in Egypt, and became professor of pathology in the Cairo Medical School. He gathered men around him and reorganised this post, which he gave up in about two years upon being offered the important position of president of the Sanitary, Maritime, and Quarantine Council of Egypt. His knowledge of both the sciences and languages concerned, his tact, and his firmness enabled him to fill this very difficult international post with great distinction up to the time of his death. He again reorganised the whole work of the department; he did himself, and superintended others in doing, a great deal of research work connected with the various diseases which the council had to guard against; he built special pilgrim stations, which are models of what such things should be, at Tor and elsewhere on the pilgrim routes, and with infinite skill managed to bring the difficult and mixed groups of pilgrims under the conditions of proper quarantine, thereby keeping deadly diseases not only out of Egypt, but also out of Europe. At the outbreak of war he became head of the Red Cross in Egypt, and he met his death in returning from Greece, whither he had gone in order to help and advance the Red Cross and sanitary organisation there.

Most of Sir Armand Ruffer's active life was spent in reorganising, making efficient, and putting on a proper scientific basis the various bodies mentioned above, in which he was the ruling spirit; but in addition to this he carried out researches on, and extending over, a number of subjects. As a pupil of Metchnikoff, it was fitting that his earliest research work should have been on phagocytosis, on which he published, in 1890, a paper which is still valuable. He then turned his attention to the still baffling subject of cancer and set himself to try to solve the vexed question of the various cell-inclusions found in the lesions of this disease, which he considered to be of parasitic origin. As a member of the Indian Plague Commission, he did work on plague which was of great use to him later in his administrative and preventive work in Egypt. Besides the bacteriological and serological research, in connection with the quarantine work, which was done in his laboratory, and of which a good deal was new, he published several papers on the pathological lesions found in mummies, of considerable importance with regard to the history and distribution of diseases; and he collected a large quantity of material on this subject which is not yet published.

As a colleague he was ideal, ever ready to help and to advise, and never thinking of himself; and he was one who had the truest, kindliest, and most appreciative affection for his many friends.

H. G. P.

NOTES.

THE long-deferred Arctic expedition of Mr. Roald Amundsen seems at last to be taking definite shape. This is the expedition which Amundsen abandoned in 1910, when he sailed instead for the Antarctic on his successful conquest of the South Pole. The plans have been modified in detail, and no longer include the use of Nansen's *Fram*, which has been condemned, but the general scheme probably remains the same. Amundsen's original intention was to enter the Arctic Ocean by Bering Strait, to traverse the unknown Beaufort Sea and force his vessel into the polar pack. He intended to allow his vessel to be frozen in and to drift with the ice across the polar basin, eventually reaching the open sea, in four or five years, between Greenland and Spitsbergen. In this respect the expedition is to be on the lines of Nansen's successful drift in the *Fram*, but by entering the ice further east than Nansen, Amundsen hopes to drift across the middle of the polar basin through quite unknown regions. Research in meteorology, oceanography, and biology will be pursued all the time, and the expedition will be accompanied by several aeroplanes for reconnaissance work. Amundsen has recently returned to Norway from America, where he has been arranging about these machines and receiving instruction in flying. It is announced that the Norwegian Storthing has voted 11,000*l.* towards the cost of the expedition. In 1914 a grant of 4000*l.* was promised by the National Geographic Society of Washington.

THE recent debate in the House of Commons on the Air Board vote has done much to explain the precise functions of the Board, and its relation to the aeronautical industry. Major Baird pointed out to those who were dissatisfied with the results of the work of the Board that it was necessary to proceed cautiously and to avoid rash experiments which might seriously affect the supply of machines to meet the demand at the front. In the debate which followed Major Baird's statement the usual criticisms were levelled at the Government machines which are being supplied to the Services, and it was asked whether more efficient machines could not be obtained in large numbers. The prevailing impression as to the inefficiency of these Government machines is entirely unfounded, and a statement made to the effect that the Air Board will consider the Royal Aircraft Factory and private firms on equal terms as regards the development of new types of machine should satisfy anyone that a firm claiming to produce a better machine than the official type will have a fair hearing before the Board. The formation of a new committee, under Lord Northcliffe, to investigate the possibility of using surplus machines and pilots for commercial purposes after the war should produce some interesting results. It is certainly high time that the possible uses of aircraft when peace returns should be seriously considered. At the conclusion of the war there will be many aircraft factories possessing expensive plant for the production of machines, and this plant may easily be wasted when the demand for military and naval machines becomes smaller. The work of the Air Board has already proved of great value in centralising and controlling the production of war machines, and there seems no reason why equally good work should not be done in peace time to advance the commercial side of aeronautics.

UNDER the title of "Science in Russia" a new reference-book will be published in the present year, composed of two parts: (*a*) an index of all scientific institutions, societies, and higher schools in Russia; (*b*) an index of all persons working in these institutions and of private scientific workers. It will thus include in the first part the particulars hitherto supplied (but very incompletely as to Russia) by the "Minerva Jahrbuch"; while the second part will be similar to "Who's Who in Science," but will give, at least for 1916, not so much information about each individual. The difficult task of collecting the necessary material is already well in hand. The undertaking has been brought, through the Russian newspapers, to the knowledge of all those interested, and special forms are being supplied to the institutions and societies, many of which have already been returned with the necessary particulars. The work has been taken in hand by the Academy of Sciences of Petrograd and the scientific periodical *Priroda* (Nature) of Moscow. "Science in Russia" for 1916 will be edited by Prof. V. N. Beneševič, and published conjointly by the Academy and the journal *Priroda* in the latter part of this year. It will be issued annually. This publication will supply a long-felt need, as up to the present the only work of reference containing any information about the scientific institutions of Russia as a whole has been "Minerva." "Science in Russia" will help towards an exact evaluation of Russian scientific forces and activity, and will constitute an important step towards the promotion of closer scientific relations with the Allied countries.

IN London, and probably at many other places in England, April was colder than any corresponding month for the last sixty years or more. Dr. H. R. Mill contributed some details of the exceptional cold weather to the *Times* of May 3. The mean temperature at Camden Square is given as 43·1°, or 5° below the average; the mean maximum was 52·6°, and the mean minimum 34·6°. The arithmetical mean of

maximum and minimum values is 43·6°. At Camden Square, April, 1860, was almost equally cold; the mean temperature was 43·9°, and the mean minimum 35·3°. In 1888 the mean maximum temperature in April was 52·4°, which was equally cold for the daytime. The Greenwich records for the last seventy-six years do not show a lower April mean, from maximum and minimum temperatures, than 44·3°, which occurred in 1887 and 1908, so that April this year was lower than previous records by 1°. The lowest April mean temperature from the hourly observations is 43·3° in 1860, and in 1879 and 1888 the mean was 43·5°. At Camden Square the mean deficiency of temperature for the five months December, 1916, to April, 1917, was 3·6°, each month being colder than the normal. The same series of observations shows 1878–79 to be correspondingly cold, whilst for 1890–91 the mean temperature for the five months was lower, and 4° less than the average. At Greenwich the coldest corresponding five months also occurred in 1890–91, when the mean was 37·6°, and 4° below the average. Other low mean temperatures for corresponding periods were 37·9° in 1878–79; 38·0° in 1844–45; 38·5° in 1846–47; 38·6° in 1854–55; 38·7° in 1887–88; 39·2° in 1885–86; and 39·5° in 1894–95.

THE Ontario Nickel Commission, appointed by the Ontario Government on September 9, 1915, to investigate the resources of the province in connection with nickel and its ores, has recently presented its report, of which a summary has reached this country. The Commissioners are the chairman, Mr. G. T. Holloway, an English metallurgist; Dr. W. G. Miller, the provincial geologist of Ontario; Mr. McGregor Young, a Toronto barrister; and Mr. T. W. Gibson, Deputy Minister of Mines, who acted as secretary In order that the report might be placed before the Legislature at the earliest possible date, 150 advance copies were struck off without the last chapter, which is a bibliography of nickel, and the index. The report proper contains more than 600 pages, and is well illustrated with cuts, diagrams, and maps. The Commissioners print a summary of the report and their conclusions on the main points of the investigation at the forefront of the volume. After references to the various countries they visited, including the United States of America, Great Britain, France, Norway, Cuba, Australia, and New Caledonia, and to numerous mines, works, plants, smelters, etc., on both sides of the Atlantic, and also to their interviews with Mr. Bonar Law, then Secretary of State for the Colonies, they address themselves to the two questions which have been uppermost in the various discussions concerning Ontario's nickel industry during the last twenty-five years, viz.:—(1) Can nickel be economically refined in Ontario? and (2) are the nickel deposits of Ontario of such a character that this province can compete successfully as a nickel producer with any other country? The Commissioners without hesitation answer both these questions in the affirmative. The full report will be studied with much interest by metallurgists in this country.

THROUGH the death of Major P. G. Bailey in action on April 26 another scientific career of promise has been cut short. Educated at Dulwich, he entered Clare College as an exhibitioner in 1905. Three years later he graduated with first class honours in the Natural Sciences Tripos. Though he passed an examination for the Eastern Civil Service, he felt that he had a bent towards research work, and instead of taking up the appointment offered he went through the agricultural course at Cambridge. Genetics attracted him; he became a Development Research scholar, and was soon immersed in animal breeding. One of the investigations on which he was engaged was that of the inheritance of wool characters in sheep, a preliminary account of which (with F. L. Engledow) appeared in the *Journal of Agric. Science* for September, 1914. It was with the idea of gaining further experience that he accompanied the British Association to Australia in 1914. He was also busy with investigations on poultry and rabbits, the first-fruits of which appeared in a paper (with R. C. Punnett) "On the Inheritance of Size in Poultry" (*Journ. Genetics*, vol. iv., 1914). The outbreak of war found him in Australia. On his return he obtained a commission in the Royal Field Artillery, and had been at the front for more than two years before his death. Bailey was a careful and conscientious worker, with a great reserve of quiet enthusiasm. He brought to his work the straightforward honesty which characterised him in the affairs of life. He had the intellectual strength to recognise facts and the courage to face them, endowments which would have carried him far in the line of his choice. Though rather shy and diffident, he had a great charm of manner, and for those who knew him well his going has made a grievous gap.

AT the Royal Society on Thursday last the fifteen selected candidates, whose names were given in NATURE of March 1, were elected by ballot fellows of the society.

THE Bakerian lecture of the Royal Society will be delivered by Mr. J. H. Jeans on May 17 upon the subject of the configuration of astronomical masses and the figure of the earth.

PROF. VICTOR GRÉGOIRE (Louvain), Prof. T. H. Morgan (New York), and Prof. Hans Schinz (Zürich) have been elected foreign members of the Linnean Society.

THE Pereira prize of the Pharmaceutical Society has been awarded to Miss Ivy Roberts, and the silver and bronze medals of the society have been awarded respectively to Mr. H. Jephson and Miss Doris Gregory.

SIR WILLIAM OSLER will deliver the annual oration of the Medical Society of London in the rooms of the society, 11 Chandos Street, Cavendish Square, W.1, on Monday next, May 14. His subject will be "The Anti-Venereal Campaign."

GENERAL G. W. GOETHALS has, we learn from *Science*, notified Governor Edge, of New Jersey, that he will accept the position of State engineer, created under a special Act during the present session of the Legislature. General Goethals will have supervision over the projected system of highways, which will cost about 3,000,000*l*.

DURING the evening of May 1 a great earthquake was registered in European observatories. In Italy seismographs continued in motion for three and a half hours. Father Alfani estimates the distance of the origin from Florence at about 7000 miles, and suggests the Pacific coast of South America as the seat of the disturbance.

THE second Sydney Ringer memorial lecture, which is delivered biennially, will be given by Prof. A. R. Cushny at University College Hospital Medical School on Friday, May 25. The subject will be "Digitalis and Auricular Fibrillation." The lecture will be open to all qualified medical practitioners and medical students.

THE Angrand prize of the Bibliothèque Nationale of Paris, of the value of 5000 francs, is to be awarded in 1918 for the best work published during 1913–17 on the pre-Columbian history, ethnography, archæology,

or linguistics of the American aborigines. Ten copies of each of the competing essays should be sent to the Secrétariat of the Bibliothèque Nationale, Paris, before January 1 next.

For the third year in succession, the war conditions make it impossible for the British Medical Association to hold the usual annual scientific meeting. The council announces, therefore, that arrangements have been made to hold the annual representative meeting in London on Thursday, July 26, and the annual general meeting on Friday, July 27. It is recommended that Sir T. Clifford Allbutt be re-elected president of the association for 1917–18.

The subject of the next triennial prize of the Royal College of Surgeons of England (consisting of the John Hunter medal in gold, or a medal in bronze and the sum of 50*l.*) will be "The Development of the Hip-joint and the Knee-joint of Man." The subjects of the Jacksonian prize for 1917 and 1918 are respectively "The Causation, Diagnosis, and Treatment of Traumatic Aneurysm, including Arterio-venous Aneurysm," and "Injuries and Diseases of the Pancreas and their Surgical Treatment."

At the meeting of the Zoological Society on May 1 the secretary, Dr. Chalmers Mitchell, announced with the deepest regret that Mr. Henry Peavot, the society's librarian and clerk of publications, had been killed in action. Mr. Peavot entered the service of the society in 1896, and, after passing through various departments, was appointed assistant librarian and clerk of publications in 1908, and was promoted to the post of librarian and clerk of publications in 1912. In every way he had gained the esteem and regard of the scientific fellows of the society, and was one of the most valuable and competent members of the society's staff.

The death is announced, in his fifty-ninth year, of Dr. H. W. Conn, professor of biology at Wesleyan University, Middletown, Connecticut, since 1889. He was for several years bacteriologist to the Storrs Experimental Station, and director of the Cold Spring Harbour Biological Laboratory and the Connecticut State Board of Health Laboratory. In 1902 Dr. Conn was president of the American Society of Bacteriologists. He was a specialist in the bacteriology of dairy products, and the author of more than 150 scientific memoirs

Having in mind the remarks made in the article on the position and prospects of professional chemists (Nature, March 29) with regard to the conditions of service offered to qualified temporary assistants in the inspection department at Woolwich, we are glad to learn that such appointments are now being made on a definite salary basis, commencing with a minimum of 175*l.* per annum. We feel that in this there is some justification for our hope that under the Ministry of Munitions the services of scientific men will meet with more enlightened appreciation.

At the annual banquet of the U.S. National Academy of Sciences held on April 17 the Henry Draper gold medal was presented to Prof. A. A. Michelson, of the University of Chicago, for his numerous and important researches and contributions to physics. Prof. Michelson's major work includes the precise determination of the velocity of light; the study of ether drift; the determination of the length of the international standard meter in terms of light waves; the measurement of tides in the body of the earth, and the invention of several very delicate and exact scientific instruments of prime importance in the study of light. Dr. S. W. Stratton, director of the U.S. Bureau of Standards, was awarded the academy medal for eminence in the application of science to the public welfare, for his services in introducing standards into the practice of technologists in the United States.

The American Museum of Natural History has sent Dr. H. J. Spinden, of its department of anthropology, on a three months' tour in Central America for the purpose of making researches in the interests of the textile industry. He will start in Guatemala and extend his investigations to Western Honduras, Salvador, and Nicaragua. In these countries are many groups of Indians whose costumes are not only picturesque, but have many details of construction which, it is thought, might be successfully adapted in the United States. Dr. Spinden, in addition to obtaining examples of designs, will learn the details of the art of weaving as there practised, and will study the dyestuffs used by the native artisans. He will also obtain information concerning the native food products, and will collect specimens of them for display in the "preparedness" exhibit which the museum now has under way.

The *American Museum Journal* for February contains a preliminary report by Mr. N. C. Nelson on the excavation of one of the finest and best preserved examples of prehistoric Pueblo architecture in the south-west. The ruin is situated in Animas Valley, in north-western New Mexico, a few miles below the Colorado boundary, and directly across the river from the town of Aztec. It was at once a great house and a great village, its inhabitants forming a closely organised community. This co-operation of work seems to have resulted from the need of providing works of irrigation, or, perhaps, also from the necessity of defence against encroaching nomads. The report is illustrated by good plans and photographs, and the account of the further progress of this important excavation will be awaited with interest.

A valuable report on child mortality at ages 0–5 years has been issued by the Local Government Board (Cd. 8496, 1916). During the four years 1911–14, 575,078 deaths occurred in England and Wales under five, or more than a quarter (28·2 per cent.) of the total deaths at all ages during these years. In some of the 274 urban areas specially considered in this report the death-rate was three times as high as in some others. While it is true that even in the most backward of the towns and boroughs much saving of child-life has already been secured, there is evidently still a large mass of preventable mortality. The centres of excessive child mortality are those in which the chief industries of the country are carried on. In degree of ignorance there is little, if any, difference between the wives of wage-earners and the wives of men belonging to other classes. The important conclusion is formulated that the difference between these two classes, apart from the handicap of the former in respect of housing, food supply, and sanitation, in the main is one of ability to secure the assistance required in the various contingencies of maternity and early childhood.

A well-illustrated account of the cane-borer beetle in Hawaii by F. Muir and O. H. Swezey comes from the Experiment Station of the Hawaiian Sugar-planters' Association (Entom. Bulletin 13). The life-history is described in detail, and much stress is laid on the importance of natural enemies in controlling the pest.

A. L. QUAINTANCE and A. C. Baker continue their studies of "white flies" (Aleyrodinæ) in a long paper in the Proceedings of the U.S. National Museum (vol. li., pp. 335–445). Many genera and species from all parts of the world are described, their structure being excellently illustrated in forty-six plates and several text figures.

WE have received the twenty-eighth and twenty-ninth reports of the State entomologist (Dr. S. A. Forbes) on the "Noxious and Beneficial Insects of Illinois" (1915–16). The former of these is devoted chiefly to the San Jose scale, and to a description of the result of extensive experiments towards the destruction of the corn-root aphis, an insect very harmful to maize. The latter contains a valuable paper on the life-history of the codling moth (*Carpocapsa pomonella*) in Illinois; from the diagrams given it appears that the larvæ of the autumn generation are far more abundant in the locality studied than those of the spring brood.

MR. J. ARTHUR HUTTON has published a report of a lecture delivered to the Manchester Anglers' Association dealing with proposals for the nationalisation of the salmon fisheries. He suggests, as remedial measures counteracting the deterioration that is in progress, the total abolition of unrestricted fishing; the control of the rivers, preferably by a separate Ministry of Fisheries; a thorough topographical and statistical survey; and strict control of the sources and means of pollution wherever these can be avoided or minimised. Artificial culture he regards as, at least, a very promising method of largely increasing the yield of the rivers, and an expensive and large-scale system of hatching and distribution of larvæ is earnestly recommended.

THE snares and pitfalls which beset those who venture to "restore" extinct animals, even where the remains are fairly complete, form the theme of an extremely interesting article by Prof. Henry Fairfield Osborn in the *Museum Journal* for January, which has just reached us. The spirited picture, with which we have now become familiar, of that very agile dinosaur, Ornitholeistes, seizing an Archæopteryx in mid-air is now, in the light of further discoveries, regarded as improbable. And we venture to predict a like fate for the restoration of the yet more remarkable dinosaur described under the name Struthiomimus. The restorations given here certainly do not carry conviction. This issue also contains an article on the autumn migrations of butterflies, which demands careful study from all who are interested in the phenomena of migration.

THE secretary to the International Commission on Zoological Nomenclature has recently issued, as Circular Letter No. 35, a list of generic names, chiefly Linnean, proposed for inclusion in the "Official List of Zoological Names." These names are those in general use, and each has been checked to see that it conforms with the rules of nomenclature. The names are: One of Protozoa, one of Cœlentera, two of Trematoda, five of Cestoda, one of Cirripedia, one of Tunicata, and twenty-eight of Pisces. The genotype of each is quoted. Anyone interested who has not received a copy of the list may obtain one from the secretary, 25th and East Streets, N.W., Washington, D.C., or from the British Commissioners, Dr. E. Hartert, Tring; Dr. W. E. Hoyle, National Museum of Wales, Cardiff; and Dr. F. A. Bather, British Museum (Natural History).

THE deplorable neglect among us of all forms of scientific investigation which do not promise immediate "economic" results formed the subject of an admirable presidential address by Prof. G. H. Carpenter to the Dublin Naturalists' Field Club in December last. In the course of this address, which appears in the *Irish Naturalist* for April, Prof. Carpenter reminded his audience of the lasting benefits to the human race which have resulted from what is, so mistakenly, called "pure science." In this connection, he proceeded to show how the study of the lower forms of life, pursued solely for the sake of knowledge, may unexpectedly prove of immense practical importance. By way of illustration, he cited some recently discovered changes of habit in certain collembola, wire-worms, and other insect pests which had adversely affected the newly introduced tobacco crop in Ireland.

La Nature for April 21 contains an article on "L'hiver 1917 dans la Scandinavie," by M. Charles Rabot. The author points out that it is not only in France that the winter has been of unusual severity; it has been equally cold in Norway and in the south of Sweden as well as in Denmark, where it has not been so severe for twenty years. At Christiania the period of cold lasted about three months, commencing December 23 and continuing to the middle of March. From December 23 to February 9 the thermometer remained below zero Centigrade, and since the establishment of the Norwegian Meteorological Service in 1861, so long a period of low temperatures has not been previously observed. The mean temperature for January was $-10{\cdot}9^\circ$ C., which is $6{\cdot}9^\circ$ below the normal, and is the coldest January for fifty-six years. The absolute minimum temperature has not been excessive. February was also very cold. The cold was accompanied by copious falls of snow, occurring at times over the whole of Norway. At Vuonatjviken, a meteorological station situated 500 m. above sea-level, in the most northern part of Sweden, the thermometer registered 55° C. below zero. Much ice obstructed navigation on the coasts and in the fjords, and the ice paralysed the operations of the submarines in these parts throughout the winter, whilst drifting mines were exploded by coming into contact with the large masses of ice. For twenty-two years the sea in southern Scandinavia has never been so full of ice.

THE December, 1916, issue of *Terrestrial Magnetism and Atmospheric Electricity* contains a report by Drs. W. Knoche and J. Laub on the electrical measurements made at Boa Vista, Brazil, during the total eclipse of the sun on October 10, 1912. The eclipse had no effect on the radio-activity of the air, or on the fall of potential upwards, or on the propagation of electric waves. The number of ions per c.c. was considerably diminished, the negative ions more seriously than the positive. The mobilities of the ions showed sharp maxima about the middle and the end of the eclipse, the ratio of the mobility of the negative to that of the positive ion having a sharp maximum about half-way between totality and end. The conductivity due to both ions was a minimum near totality and a maximum near the end. Curves are given showing the variation of each element observed during the whole eclipse.

AT a recent meeting of the Institution of Petroleum Technologists an interesting paper on the little-known oilfields of Assam was read by Mr. H. S. Maclean Jack. These oilfields are being worked by the Assam Oil Company, which, after eighteen years of strenuous labours, has at last reached the stage of active production. The paper describes the great diffi-

culties met with, first in locating, and afterwards in drilling, oil-wells, the latter having been to some extent overcome by the use of the American rotary drill. The petroleum occurs in Assam in intermittent deposits, situated in loose sands; the gas pressure is very high, and the oil when first struck gushes out with much violence; the wells do not produce any very great quantities, but keep up a reasonably steady flow for considerable periods. The crude oil is very dark, and has a density of 0·856; it is distilled in the ordinary way in continuous boiler stills, the products being crude benzene, intermediate kerosene, ordinary kerosene, and a residue which is distilled to dryness in pot-stills. These latter produce "batching" oil, used for softening jute fibre; some lubricating and other heavy oils; a large proportion of paraffin wax, this being a hard wax with a melting point of 135° to 140° F.; and a coke, which is nearly pure carbon. The kerosenes supply the local demand, and are shipped also to Bengal, whilst the paraffin wax finds a market in all parts of the world.

Engineering for April 27 contains an interesting account, with illustrations, of a new machine-gun shop belonging to Messrs. Vickers. This shop had to be erected, equipped, and started up with great rapidity in order to meet the demands of our forces at the front. The floor area is nearly 2·5 acres, accommodating more than 1000 machines of specialised type, driven by electric power transmitted through 6000 ft. of line shafting and 40,000 ft. of machine belting, and yet actual manufacturing work was started within three calendar months of the date when the ground —a potato field—was first taken possession of, while in two months more the factory was in complete working order, and a steady supply of machine-guns was being dispatched to the front. More satisfactory still, the whole of the machining work in the manufacture of these machine-guns—one of the most intricate units of mechanical production—is carried out by women workers. In connection with this, it is of interest to note that many of our women workers have now got beyond the mere operation of automatic and semi-automatic machine tools, and are being trusted with work and machines formerly operated by skilled machine hands.

OUR ASTRONOMICAL COLUMN.

A New Comet (Schaumasse).—The second new comet of this year was discovered at the Nice Observatory on April 25 by M. Schaumasse. The magnitude at the time of discovery was 9·5, and the comet is said to be increasing in brightness. A Copenhagen telegram announces that on April 27 the comet was observed at the Lick Observatory by Mr. Shane, its position at 16h. 1m. 3s., Lick Mean Time, being R.A. 23h. 7m. 40s., decl. +11° 36′ 57″. According to the *Times* of May 9, the following positions for Greenwich midnight have been calculated by J. Braae and J. Fischer-Petersen, Copenhagen :—

1917		R.A. h. m. s.		Decl. ° ′
May 9	...	23 32 0	...	+23 14
16	...	0 21 0	...	38 46
20	...	1 54 0	...	52 36
22	...	3 25 55	...	58 36
24	...	5 16 30	...	58 41
26	...	6 44 42	...	53 52
28	...	7 39 49	...	47 19

Comet 1917*a* (Mellish).—The following continued ephemeris for Greenwich midnight has been received from J. Fischer-Petersen, Copenhagen :—

1917	R.A. h. m. s.	Decl ° ′	Log *r*	Log Δ	Brightness.
May 11	1 26 3	−10 31·0	9 9677	0 1661	6·2
13	29 45	10 54·6			
15	33 20	11 17·0	0·0072	0·1825	6·5
17	36 48	11 38·5			
19	40 9	11 59·3	0·0422	0·1968	6·7
21	43 23	12 19·6			
23	46 30	12 39·6	0·0738	0·2093	7·0
25	49 31	12 59 4			
27	52 26	13 19·2	0·1024	0·2204	7·2
29	55 15	13 39·0			
31	1 57 57	13 58·9	0·1286	0·2300	7·3
June 2	2 0 33	14 19·0			
4	2 3 4	−14 39·3	0·1527	0·2386	7·5

Comet 1916*b* (Wolf).—The following is a continuation of Prof. Crawford's ephemeris for Greenwich midnight, as given in the Lick Observatory Bulletin No. 289 :—

1917		R.A. h. m. s.	Decl. ° ′	Log Δ	Brightness
May 10	...	20 55 38	+15 5·7	0·1646	
11	...	20 58 4	21·9		
12	...	21 0 29	38·1	0·1599	3·63
13	...	2 54	15 54·2		
14	...	5 19	16 10·1	0·1553	
15	...	7 43	25·9		
16	...	10 7	41·6	0·1507	3·85
17	...	12 31	16 57·2		
18	...	14 54	17 12·6	0·1462	
19	...	17 17	27·9		
20	...	19 39	43·1	0·1418	4·06
21	...	22 1	17 58·1		
22	...	24 23	18 12·9	0·1374	
23	...	26 44	27·5		
24	...	29 5	41·9	0·1330	4·28
25	...	31 26	18 56·1		
26	...	33 46	19 10·2	0·1287	
27	...	36 5	24·1		
28	...	38 24	37·7	0·1245	4·49
29	...	40 42	19 51·1		
30	...	43 0	20 4·3	0·1203	
31	...	45 17	17·3		
June 1	...	21 47 34	+20 30·0	0·1162	4·71

The Aquarids of Halley's Comet.—These meteors were perseveringly awaited on the mornings between about April 28 and May 7 by a number of observers, including Miss A. G. Cook, Mrs. F. Wilson, the Rev. J. C. W. Herschel, Mr. T. Hargreaves, Miss T. E. Gall, Mr. W. F. Denning, and others. The results were somewhat disappointing, though the weather proved favourable on the whole. Very few meteors of the Aquarid shower were seen. On May 1, at 14h., a fireball directed from a radiant at 50°+71° was recorded by Mrs. Wilson and Miss Gall, at Totteridge, and Miss Cook, at Stowmarket. It fell from a height of sixty-three to thirty-eight miles over the Channel, between Boulogne and Sussex. Another fireball was seen on the morning of May 7 from Totteridge, and this proved an Aquarid. From the collected observations it appears that the shower, though unusually scanty in numbers, was visible over the nine mornings from April 28 to May 7.

OSMOTIC PRESSURE.

The theory that osmotic pressure is due to bombardment of the walls of the containing vessel by the particles of solute has met with considerable criticism, both from the chemical and physical sides (compare, *e.g.*, van Laar, Proc. Amsterdam Academy, vol. xvii., p. 1241; vol. xviii., p. 184; abstracted in Nature, March 16, 1916). However, at the discussion on osmotic pressure before the Faraday Society on May 1, with Sir Oliver Lodge in the chair, the kinetic

theory more than held its own. It was claimed by Prof. A. W. Porter that this theory is the only one which gives directly the experimentally obtained values for dilute solutions; that it has now been placed on a sound experimental basis as a result of Perrin's investigations, which show that particles suspended in a liquid, and therefore also the molecules of the solute, are in rapid motion to the precise amount required by the theory; and that any other theory of osmotic pressure must not only be competent to account for the observed facts, but must explain the absence of the effects that we have a right to expect from the molecular agitation of the solute. These claims were not seriously shaken by the criticisms of subsequent speakers, and towards the close of the meeting the chairman expressed his general agreement with the arguments put forward in favour of the kinetic theory.

Mr. W. R. Bousfield's contention that it is the solvent and not the solute which is active in osmotic pressure may be met, as Sir Oliver Lodge pointed out, in a simple and therefore necessarily incomplete way as follows. Imagine a closed vessel full (or practically full) of water, and divided into two compartments by a semipermeable membrane. The pressures on the two sides of the membrane compensate each other, but if a little sugar is dissolved in one compartment an *additional* pressure, due to the presence of the solute, is set up on that side. The contention that it is necessary to look to the solvent, and the solvent only, as the source of the pressure is therefore not established, but Bousfield's view that osmotic pressure is connected with the presence of solvent vapour (approximately obeying the gas laws) in the molecular interspaces deserves consideration on its merits.

It will not be denied that there are difficulties in applying the kinetic theory to relatively concentrated solutions (more particularly as regards the correction for the volume of the solute), just as there are difficulties in the application of the kinetic theory to compressed gases. It is remarkable that the deviations from the simple gas laws are smaller for solutions than for gases, and in one case at least (compare Sackur and Stern, *Zeitsch. physikal. Chem.*, 1912, vol. lxxxi., p. 441) this has been shown to be in accordance with the kinetic theory of osmotic pressure.

Both Prof. Porter and Mr. Bousfield ascribe the deviation of osmotic pressure from simple laws solely to hydration of the solute, and proceed to calculate the degree of hydration of the solute particles on this assumption. As, however, such simple laws do not hold for the gaseous state, in which hydration is necessarily absent, these "hydration numbers" do not inspire much confidence, more particularly as the variation of some of them with concentration in relatively dilute solution appears difficult to reconcile with the law of mass action. Unfortunately they cannot be independently tested, as no satisfactory method of measuring hydration in solution has yet been discovered.

Although the magnitude of the osmotic pressure, as equilibrium pressure, is independent of the nature of the membrane provided the latter is truly semipermeable, the mechanism of osmosis, including the part played by the membrane, is of great interest and importance. The very suggestive investigations of Adrian Brown and Tinker on the permeability and other properties of membranes have already added substantially to our knowledge of these questions. As regards the bearing of theories of osmotic pressure on osmosis, the suggestion of van Laar that the pressure of the sugar molecules as postulated by the kinetic theory would prevent water flowing inwards does not appear well founded. The most satisfactory picture of the process is probably obtained by analogy with Ramsay's well-known experiment with a cell provided with a palladium membrane permeable for hydrogen, but not for nitrogen. Although the cell contained nitrogen at half an atmosphere pressure, when it was surrounded by hydrogen the latter entered until its partial pressure inside was practically equal to its pressure outside.

G. S.

ECONOMICS OF LIFE INSURANCE.

SIX papers relating to problems of life insurance, read to the Economic Section of the American Association for the Advancement of Science last December, are printed in the *Scientific Monthly* for April. Of these, the most important, in view of what has happened since it was read, is that by Prof. Huebner, of the University of Pennsylvania, on "Life Insurance and the War." For all the belligerents he finds that the financial effects of the war on the companies by depreciation of investments have been serious. For England and Canada the war claims have been between 11 and 12 per cent. of the total claims, which is a favourable experience; for the enemy countries little information is to be had. The same observation applies to the terms upon which companies undertake war risks. The after-effects of the war on the health of survivors must not be overlooked. The author urges that the companies should have latitude to charge such extra premiums as may be necessary, but that the burden should to some extent be borne by the community as a whole.

Prof. Huebner submits for consideration by the companies proposals for refunding any excess extra premium at the close of the war, and for reinstatement of the policy where the insured, owing to the war, is unable to produce evidence of good health. These proposals will no doubt be attractive, but they are open to the objection that contracts based on a calculation of averages cannot be modified by after-results in individual cases.

A paper by Mr. E. E. Rittenhouse shows that the life insurance companies of New York State have increased their new insurances in the thirty years 1885–1915 from 65,000,000*l.* to 385,000,000*l.*, and that the proportion of insurances lost by lapse and surrender during that period is a little more than 40 per cent., and tends to diminish.

Three of the papers relate to a recent development of the functions of life insurance companies in the United States. Dr. Fisk, as medical director of the Life Extension Institute, a body organised in 1914, urges health conservation as a duty incumbent upon these companies. Mr. Cox, who represents an influential association of life insurance presidents, asserts that nearly every large company in the United States is doing something intended either to prolong the lives of its policy-holders or of the people generally. Mr. Haley Fiske gives particulars of the work of a life extension bureau for medical examination of insured persons and of other comprehensive measures adopted by the companies for the preservation of the health of the insured.

Dr. Hoffman, statistician to the Prudential Insurance Company of America, improves the occasion offered by these recent developments to expose some fallacies of compulsory health insurance. He considers that voluntary effort can be relied upon to bring about all the benefits that could be expected from compulsory measures. He meets the argument that compulsory insurance has had good effect in Germany and in England in the fight against tuberculosis by statistics showing that Massachusetts has reduced its mortality from that cause by 23·8 in 10,000, while the corresponding reduction in Germany has

been only 17·6 in 10,000, and in England even less. He contends that compulsory health insurance is primarily a question of taxation, as 20 per cent. of the cost is to be paid out of general revenues for the specific benefit of a selected group, which is merely poor relief under another name, and is indirect taxation in its most pernicious form, and contrary to the fundamental principles of republican government.

THE UNITED STATES NATIONAL RESEARCH COUNCIL.

AN important feature associated with the April sessions of the National Academy of Sciences at Washington, D.C., was the meeting of the National Research Council. The Research Council is made up of eminent men of science who are members of the academy, and of representatives of the military bureaux of the Government, and it co-operates with the United States Government in the solution of scientific problems.

Dr. G. E. Hale, of the Mount Wilson Solar Observatory, chairman of the council, presided at the meeting, and reports were presented by Dr. C. D. Walcott, secretary of the Smithsonian Institution, for the Military Committee; Dr. R. A. Millikan, of the University of Chicago, for the Physics Committee; Dr. M. T. Bogert, of Columbia, for the Chemistry Committee; and Dr. V. C. Vaughan, director, Medical Research Laboratory, University of Michigan, for the Medicine and Hygiene Committee.

In connection with the work accomplished by the Military Committee, Dr. Walcott, who is also a member of the National Advisory Committee for Aeronautics, stated that investigations had been conducted with noxious gases as employed for military purposes; problems connected with all forms of signalling had been studied; the utilisation of opium for obtaining a supply of morphine for medical purposes had been considered; and improvements had been suggested in the service Army blanket, which is not thought to be warm enough. Other work for military establishments of the Government is confidential. The Army was represented by Maj.-Gen. W. C. Gorgas, Brig.-Gen. William Crozier, and Brig.-Gen. George O. Squier, the chiefs of the medical, ordnance, and aviation divisions of the Army. Representatives of the Navy are:—Rear-Admiral D. W. Taylor, chief constructor; Rear-Admiral R. S. Griffin, engineer-in-chief; and Dr. J. Gatewood, medical director, Navy Medical School. The other members of the committee are:—Dr. S. W. Stratton, director of the Bureau of Standards; Mr. Van H. Manning, director of the Bureau of Mines; Prof. C. F. Marvin, chief of the Weather Bureau; and Mr. H. E. Coffin, Council of National Defence, Naval Board, and Research Council.

In reporting for the Committee on Physics, Dr. R. A. Millikan stated that they were co-operating with the National Society and the American Association for the Advancement of Science in an effort to find the men and the means for attacking certain physical problems which are now confronting the National Government. While no information as to the exact nature of these researches was announced, the chairman stated that four or five of them were submarine problems, several pertained to aeronautics, and some were optical, having to do with range-finding devices and the production and use of optical glass. Experiments with X-rays are being conducted for the Government, as are studies in thermal conductivity, atmospheric electricity, as encountered by airships, and even the manufacture of guns.

The study of these problems has brought to life the vital need for a central co-ordinating body, such as the National Research Council. For example, certain questions concerning the submarine were being considered separately by a naval investigating board, three of the industrial research laboratories, and a number of universities before the solution of its various phases was undertaken and distributed by the council. Encouraging results have been secured as the committee has become familiar with the general lines of attack of each investigation An important problem, which on April 1 was in a discouraging condition, is now well under way towards solution. The members of the committee include: Dr. F. P. Jewett, Western Electric Company; Prof. T Lyman, Harvard; Dr. I. Langmuir, General Electric Company; Prof. C. E. Mendenhall, University of Wisconsin; Prof. E. Merritt, Cornell; Dr. P. N. Pupin, Columbia; Dr. S. W. Stratton, Bureau of Standards; Brig.-Gen. George O. Squier, U.S.A.; Prof. A. G. Webster, Clark University; and Prof. R. W. Wood, Johns Hopkins.

Other committees of the council are on educational institutions, nitrate supply, census of research, astronomy, botany, zoology, agriculture, physiology, geography, geology, and anthropology. Another special co-operating body, the Engineering Foundation, established to promote scientific and engineering research, and representing several American engineering organisations, is giving the entire available income from its endowment to the work of the National Research Council.

The purpose of the Research Council is to pursue organised investigation for the Government when such investigation is needed, in co-operation with the department desiring the experiments or data. It brings into co-operation existing governmental, educational, industrial, and other research organisations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The executors of the late Sir Charles Holcroft, Bart., have informed the University Council that the deceased baronet bequeathed to the University the sum of 5000*l.* upon trust, to apply the income thereof to the promotion and encouragement of research work in connection with any of the following subjects, viz. physics, chemistry, zoology, botany, geology, engineering, mining and metallurgy. Sir Charles Holcroft contributed, during his lifetime, about 100,000*l.* to the University.

The Rev. John Howell has presented to the Odontological Museum a further collection of skulls and teeth from the Congo region.

PROF. W. R. SCOTT, of the University of Glasgow, will deliver the Jevons Memorial Lectures on "Economic Problems of Peace after War" at University College, Gower Street, on Tuesdays and Fridays, beginning on Tuesday, May 15. The subject of the first lecture will be "The Economic Man and a World at War." The lectures will be free to the public.

DR. WILLIAM PRICE, of Southerndown, Glamorgan, at one time an active member of the council and court of governors of the University College of South Wales and Monmouthshire, died at Southerndown on January 11 last. By his will, of which the principal of the college is one of the executors and trustees, it is provided that the residue of his trust estate, after payment of certain legacies, annuities, gifts, and devises, shall be bequeathed to the council of the college to be devoted to the medical department of the college

according to the directions and discretions of the council. The residue of the estate will probably amount to something approaching the sum of 20,000*l.*

An exhibition of official photographs illustrating various types of work on which women are employed in engineering and other industries on munitions of war is to be held at the South-Western Polytechnic Institute, Manresa Road, Chelsea, S.W.3, from Monday, May 14, until Saturday, May 26, between the hours of 10 a.m. and 7 p.m. The photographs, which have been lent by the Ministry of Munitions, illustrate the employment of women, and include work in general engineering, foundry, machine tools, optical munitions, aircraft, aeroplane engines, woodwork, shells, guns and gun components, machine-guns, fuses, and cartridges. All who are interested to see these photographs are invited. Admission is free. The Ministry of Munitions has recently held a similar exhibition at the Royal Colonial Institute, and also at one or two towns in England.

Most of the museums in this country have long recognised the desirability of interesting school children, and have had various schemes of lectures and demonstrations for the pupils. Owing to exigencies of the curricula of elementary schools, however, it has not often been possible to arrange for an extended course of museum lectures for any particular school or schools. At Liverpool, where many schools have been taken over for other purposes, an opportunity has recently occurred of giving systematic lectures on an extended scale, and a report by Dr. J. A. Clubb, Prof. W. A. Herdman, and Mr. E. B. Turner (the Senior Inspector of Schools) has been published. From this it seems that the lecturers and inspectors alike are astonished at the way in which the children can sketch and describe what they have seen, and in the opinion of the inspectors the experiment has proved "an unqualified success." The Liverpool pupils were fortunate in having lessons from Prof. Herdman, Prof. Newstead, Mr. R. D. Laurie, and Miss Bamber.

A national conference on the subject of educational reconstruction was held on Thursday, May 3, at the Central Hall, Westminster, under the chairmanship of the Rev. W. Temple president of the Workers' Educational Association. The resolutions submitted to the conference, and carried with some amendments, covered the whole educational ground from the provision of nursery schools for children between the ages of two and six up to entrance to the university, for it was unanimously affirmed that the object of educational reform will not be attained until a broad highway is established from the elementary school to the university. One of the most pressing and important series of resolutions agreed to was that dealing with the educational needs of boys and girls who at present enter on some form of occupation on leaving the elementary school, and it was emphatically laid down that this education should not be confined to the development of the minds, but must be also directed towards that of the bodies and characters of such pupils. As passed by the conference the resolutions in this connection read as follows:—1. (*b*) All forms of exemption under the age of fourteen to be abolished; the leaving age to be raised to fifteen (without exemption) within a period of five years, and to sixteen within a further period of three years; maintenance allowances to be provided to children above the age of fourteen; and child labour for profit or wages to be abolished during the period of compulsory full-time attendance at school. 2. (i) Compulsory part-time education of not fewer than twenty hours per week (including time spent in organised games and school meals) to be provided free for all such young persons, up to eighteen years of age, as are not receiving full-time education; such education to be given in the daytime. 2. (ii) The hours of labour for all young persons under the age of eighteen to be limited to a maximum of twenty-five per week. If, moreover, statutory approval be given to the demand of the conference that "the size of all classes in elementary schools be immediately reduced to forty as a maximum with a view to a further reduction to thirty," not only will a better foundation be laid for the further education of part-time artisan pupils, but the superstructure in the secondary schools will be considerably strengthened. The conference resolved that its resolutions shall be pressed forward in every possible direction without delay.

SOCIETIES AND ACADEMIES.

London.

Royal Society, April 26.—Sir J. J. Thomson, president, in the chair.—G. W. **Walker**: The effective inertia of electrified systems moving with high speed. If it is assumed that an electron moving with speed KC (where C is velocity of light) becomes deformed so that the surface is of the form $(1-k^2)^{-1}x^2+y^2+z^2=a^2$, Lorentz has shown by the "quasi-stationary" assumption that the inertia for longitudinal inertia is $m_0(1-k^2)^{-\frac{3}{2}}$, and for transverse inertia $m_0(1-k^2)^{-\frac{1}{2}}$. The same results follow from Einstein's "relativity" theory. In the paper the inertia is determined by a method developed in a former paper (*Phil. Trans.*, A, vol. ccx., p. 145), which depends directly on the primary equations, and is free from the error that the quasi-stationary method may introduce. The results are that for a "contracted" electron the longitudinal inertia is—

$$m_0\left(1-\frac{1}{5}k^2\right)(1-k^2)^{-\frac{3}{2}},$$

and the transverse inertia is—

$$m_0\left(1+\frac{11}{60}k^2\right)(1-k^2)^{-\frac{1}{2}}.$$

—Dr. G. W. C. **Kaye**: The composition of the X-rays from various metals. The X-rays from a bulb excited by low voltages (10,000 to 50,000 volts) are rich in the characteristic radiation of the anticathode. In the case of iron, nickel, and copper the amount of K-radiation lies between 80 and 90 per cent. In the case of platinum the proportion of L-radiation is from 40 to 60 per cent. Evidence of characteristic radiations softer than the K- and L-radiations has been obtained.—Dr. C. H. **Browning** and Dr. S. **Russ**: The germicidal action of ultra-violet radiation and its correlation with selective absorption. (1) A new method is described which renders it possible to determine what portion of the ultra-violet spectrum is most effective in germicidal action, and, further, to specify the wave-length of the radiation at which such action practically ceases. (2) The method has been applied to test the range of susceptibility of a number of different pathogenic organisms. By the process described it is possible to expose cultures of two different organisms simultaneously to the same intensity and character of radiation. The ranges of susceptibility of *B. typhosus* and *B. coli* are closely similar and practically the same as those of organisms such as staphylococcus pyogenes aureus and the meningococcus. (3) A striking feature of the germicidal action of the radiation in question is its abrupt termination at a wave-length of about 2960 Å.U. (4) It has been

possible to correlate this feature with "selective absorption," for it is found that the organisms exhibit marked absorptive power for just those rays which have germicidal action.—E. C. **Hort**: Morphological studies in the life-histories of bacteria. According to current theory the life-history of the "lower" bacteria is one of great simplicity, reproduction taking place—apart from endosporulation, in certain cases, of a special type—solely by transverse binary fission. This theory is mainly based on the unquestioned fact that transverse binary fission is the rule in standardised laboratory cultures. In the present communication evidence is produced to show that the life-cycle of the "lower" bacteria, as illustrated by the members of the enteric group, so far from being solely represented by perpetual binary fission, is one of great complexity, and includes an invisible, or almost invisible, stage. The nature of the evidence presented excludes the presence of contaminants, or of "involution" forms, as reasonable explanations of the recorded observations, and throws grave doubt on the adequacy of the mutation theory to explain morphological aberrancy from type —laboratory type—amongst the bacteria.

Geological Society, April 18.—Dr. Alfred Harker, president, in the chair.—Prof. H. H. **Swinnerton** and A. E. **Trueman**: The development and morphology of the ammonite septum. Two methods of studying the septum (not merely the suture) were used:—(1) Cleaning the face of the septum completely; (2) filing away the surface of the whorl in successive layers, and thus making a series of sections—called septal sections—of the septum parallel to its periphery. An instrument was designed for measuring accurately the variations in level of the face of the septum in relation to a definite datum-plane; and also the thickness of the layers filed off from the whorl. *Dactylioceras commune, Sphaeroceras brongniarti*, and *Tragophylloceras loscombi* were chosen as types with normally shaped, greatly depressed, and greatly elevated whorls respectively. A contoured plan of the adult septum of Dactylioceras shows that half the septum lies approximately in one plane and that the posterior folds or lobes occupy a greater area than the anterior folds or saddles. It also confirms the view that the septum is, on the whole, convex forwards. In all three types the axes of the folds remain approximately at right angles to the periphery through all the changes in shape of the whorl. Incompletely formed septa indicate that secretion commences at the umbilical angle and at a definite distance from the preceding septum Asymmetry of the septum, and of the suture-line, in ammonites is more common than is usually supposed. It may arise in one of two ways, namely, (1) by the different development of the elements of opposite sides; (2) in association with the lateral displacement of the siphuncle. Asymmetry of the latter type has been considered as of systematic importance. Nevertheless, while it does arise more frequently in certain genera, as, for instance, in Psiloceras and Hoplites, it occurs not uncommonly in many other unkeeled ammonites.

Mathematical Society, April 19.—Prof. H. M. Macdonald, president, in the chair.—Prof. W. **Burnside**: A liquid gyrostat.—G. N. **Watson**: The integral formula for generalised Legendre functions.—Prof. H. **Hilton**: A substitution permutable with the transposed substitution.

May 3.—Sir J. Larmor, vice-president, in the chair. —G. H. **Hardy**: Sir George Stokes and the theory of uniform convergence.—Prof. E. W. **Hobson**: Hellinger's integral.—Dr. W. P. **Milne**: A symmetrical condition for co-apolar triads on a cubic curve.

Challenger Society, April 25.—Capt. Alfred Carpenter in the chair.—Dr. S. F. **Harmer**: (1) A submarine cable damaged by the bite of a shark; the injured portion, brought up from a depth of 252 fathoms off the west coast of South Africa, was pierced by the tooth of a shark (*Oxyrhina spallanzii*). (2) Cetacea stranded on the British coasts during 1915 and 1916; of special interest were examples of Cuvier's whale, a very young sperm whale, a white-sided dolphin, and a killer of very large dimensions.—E. **Heron-Allen** and A. **Earland**: (1) A new type of Arenaceous Foraminifera; this showed a remarkably selective use of entire sponge spicules of a single species. (2) An unidentified enemy attacking Foraminifera; the enemy organism sought to bore through the test of Biloculina.

Royal Anthropological Institute, May 1.—Mr. A. L. Lewis in the chair.—J. Reid **Moir**: Some human and animal bones, flint implements, etc., discovered in two ancient occupation-levels in a small valley near Ipswich. The excavations, carried out over two years, have shown that two well-marked occupation-levels occur in the deposits covering the sides of the valley. Since these floors were occupied by man the valley has suffered denudation and erosion. The lowermost floor has yielded animal bones, including elephant and ancient types of horses, and three portions of the human skeleton, viz., a skull fragment and part of the shafts of a humerus and femur. These are not referable to the same individual, but probably two or three persons are represented. The associated flints are of Upper Le Moustier type, and were associated with fragments of primitive pottery. The upper floor contains implements of the Aurignac culture, while in the hill-wash overlying this floor two specimens of Early Solutré implements have been found. The surface soil above the hill-wash has yielded a tanged and barbed Neolithic arrow-head. Thus an orderly sequence of industries has been established such as occurs in Continental caverns. The implements have been examined by Prof. v. Commont, who agrees with the description of them given above. It would appear that the hill-wash covering the upper floor was deposited during a period of low temperature occurring at the close of Upper Palæolithic times.

Manchester.

Literary and Philosophical Society, April 3.—Prof. S. J. Hickson, president, in the chair.—R. B. **Fishenden**: Illustration processes used in scientific publications. In the case of diagrams and other drawings in pure line the most satisfactory results are obtained by the use of a waterproof Indian or Chinese ink upon a smooth hard-surfaced paper, or Bristol board. All the lines must be equally black and firm; if they are broken, or have serrated edges, the defects generally become more pronounced in the reproduction. Unless it is impracticable for other reasons, the original drawings should be made to be reproduced to half or two-thirds their lineal dimensions. Photographs may conveniently be converted into line drawings by drawing over the outlines with waterproof ink and then bleaching out the original print. Photographs for reproduction by collotype or by the half-tone process are preferably black, glossy "bromide" prints, or "gelatino-chloride" prints of a purple-brown tone. Sepia wash drawings are more satisfactory for photographic reproduction than those made in pure black and grey.

Paris.

Academy of Sciences, April 25.—M. A. d'Arsonval in the chair.—H. **Deslandres**: The influence of intense and prolonged gunfire on the fall of rain. Heavy rainfall

has been generally regarded as a consequence of prolonged cannonades, although the scientific evidence is not conclusive on the point. From a theoretical point of view this effect may be regarded as probable, as ionisation of the air is produced in several ways during the discharge of artillery, and this might provoke precipitation in the case of air charged with moisture. Experimental work on the degree of ionisation of the air and the intensity and sign of the electric field is suggested.—G. **Lemoine**: Observations on the preceding communication. If the frequent and prolonged discharge of artillery has any influence on rainfall this can only be the case for small falls; heavy and prolonged rain can only be explained by the action of large atmospheric currents.—M. **Tisserand**: Agricultural teaching in France. Improvements of which it appears susceptible. Comparisons with results obtained in Belgium, Denmark, and Germany show that much increased yields of agricultural produce and animals might be expected as a result of improved agricultural education. France has always applied without delay the results of scientific research to the culture of the vine and with great practical success, and the proposals put forward should lead to similar improvements in other fields of agriculture.—M. Quénu was elected a member of the section of medicine and surgery in the place of the late Ch. Bouchard.—G. **Julia**: The reduction of non-quadratic indeterminate conjugated forms.—W. H. **Young**: The differentiation of functions with limited variation.—E. **Kogbetliantz**: The summation of ultra-spherical series.—P. **Pascal**: The neutral and acid sulphates of sodium. Studies of the equilibrium of the ternary system H_2SO_4—Na_2SO_4—H_2O between wide limits of temperature (−45° C. to +210° C.), the results being shown on a diagram in trilinear projection.—Ed. **Chauvenet**: The zirconyl radical, ZrO. Conductivity, cryoscopic, and thermochemical experiments are cited proving the existence of this radical in zirconium compounds.—J. **Bougault**: Isomerisation in the ethylenic acids by migration of the double bond. $\alpha\beta$-Phenylcrotonic acid, $C_6H_5.CH_2.CH{=}CH.CO_2H$. The action of boiling alkalies on these acids is usually represented as producing a transformation of the $\beta\gamma$ into the $\alpha\beta$ acids. In reality the reaction is a reversible one, but the point of equilibrium in the majority of cases is very near the total transformation into $\alpha\beta$ acids. Some experimental proofs of the existence of this equilibrium are given.—F. **Grandjean**: An attempt at orientation of the salts of cholesterol and anisotropic liquid oleates on crystals.—P. **Lesage**: The germination of seeds in saline solutions.—H. **Coupin**: The influence of calcium salts on the absorbent root hairs. Calcium as carbonate, chloride, and nitrate may prevent the proper development of the root hairs of a plant. Calcium sulphate appears to be without effect.—A. **Guilliermond**. Contribution to the study of the fixation of the cytoplasm.—J. **Amar**: The price of movement in invalids and persons who have recently lost the right arm. The use of a limb or a portion of a mutilated limb by mutilated soldiers produces a fatigue in excess of that produced by the same movements in normal persons.—H. **Bordier** and G. **Roy**: The colloidal state of camphor in water in presence of camphorated oil. Biological and therapeutical consequences. Camphor in solution in water is in the colloidal state, and this accounts for the discrepancies between the solubility coefficients for camphor in water given by different authors.—M. **Fonzes-Diacon**: The white turbidity in wines (*casse*). The modern treatment of wine by sulphurous solutions of ammonium phosphate predisposes the wine to the white *casse*. This defect may be reduced or prevented by citric acid, although in some cases the legal limit is too small, and by oxalic acid or oxalates, toxic products the use of which is forbidden by law.—A. **Chantemesse**, L. **Matruchot**, and A. **Grimberg**: A new micro-organism, *Mycobacillus synovialis*, causing in man a disease developing like articular rheumatism.

WASHINGTON, D.C.

National Academy of Sciences, Proceedings No. 3, vol. iii. (March).—I. **Langmuir**: The condensation and evaporation of gas molecules. A discussion of the evaporation *versus* the reflection theory, with conclusions favouring the former.—S. B. **Nicholson**: The ninth satellite of Jupiter. Comparison of the orbits of the eighth and ninth satellites. The mean period of the ninth is 745 days, and its diameter is probably about fifteen miles.—H. E. **Jordan**: Aortic cell clusters in vertebrate embryos. The hæmogenic activity of embryonic endothelium is a normal function at a certain stage of embryonic development.—H. **Jordan**. Rheotropism of *Epinephelus striatus*, Bloch. The lip region is the most sensitive part of the body surface. The end organs of tactile sensitivity serve also as organs of rheotropic sensitivity.—J. **Rosenbaum**: Studies of the genus Phytophthora. A search for determining characters of diagnostic values in testing the different species.—E. H. **Hall**: A possible function of the ions in the electric conductivity of metals. A discussion of the number of ions necessary to maintain currents of great density, and of the temperature relations of conductivity if due to ions.—W. **Bowie**: The gravimetric survey of the United States. A summary of the present position of the subject.—S. J. **Barnett**: The magnetisation of iron, nickel, and cobalt by rotation, and the nature of the magnetic molecule. A confirmation of the assumption that only electrons are in orbital revolution in all the substances investigated.—D. L. **Webster** and H. **Clark**: The intensities of X-rays of the L series. A discussion of the intensities in the case of platinum as functions of the potentials producing them.—C. C. **Little**: The use of vasectomised male mice as indicators.—F. H. **Seares**: Photographic magnitudes of stars in the selected areas of Kapteyn.—N. C. **Nelson**: Archæology of mammoth cave and vicinity: A preliminary report. Two isolated horizons of culture have been found, one indicating an agricultural people, the other a hunting people.—R. H. **Chittenden** and F. P. **Underhill**: The abnormal state is due to a deficiency in some essential dietary constituent or constituents presumably belonging to hitherto unrecognised but essential components of an adequate diet.—F. N. **Cole**, Louise D. **Cummings**, and H. S. **White**: The complete enumeration of triad systems in fifteen elements. There are eighty types.—E. L. **Nichols**: New data on the phosphorescence of certain sulphides.—A. C. **Redfield**: (1) The reactions of the melanophores of the horned toad. (2) The co-ordination of the melanophore reactions of the horned toad.—E. C. **Jeffrey**: Petrified coals and their bearing on the problem of the origin of coals. Coals containing "coal balls" are abnormal, but there is no good evidence that "coal balls" are organised from material accumulated *in situ*.—C. **Zeleny**: The effect of degree of injury, level of cut and time within the regenerative cycle upon the rate of regeneration.—F. H. **Seares**: Preliminary note on the distribution of stars with respect to the galactic plane. A comparison of Mount Wilson counts with Kapteyn's, in which good agreement is found; as compared with both, the results of Chapman and Melotte are not homogeneous.

PETROGRAD.

Imperial Academy of Sciences (Physico-Mathematical Section), January 18.—**A. A. Markov**: Some limiting formulæ of the calculus of probabilities.—**V. V. Zalenskij**: The structure of the female sexual organs and the ripening of the egg of *Salpa bicaudata*.—**A. S. Vasiljev**: The transit instrument and the zenith telescope in latitude observations.—**O. I. Kuzeneva**: Plants collected by V. C. Dorogostajskij in the Jablonovoj range (East Siberia).—**K. A. Nenadkevič**: The bismuth minerals of Transbaikalia.—**O. V. Rosen**: The malacological fauna of the province of Terek. Description of two new species of the genus Buliminus from Transcaucasia.—**A. Šestakov**: Materials for the fauna of the Vespidæ of the genus Cerceris, Latr. (Hymenoptera, Crabronidæ), of Turkestan.—**V. Soldatov**: Notes on two new species of Lycodes from the Okhotsk Sea.—**V. A. Steklov**: The approximation of functions by means of Čebyšev's polynomials, and on quadratures.—**A. A. Borisïak**: The osteology of the genus Indricotherium.

BOOKS RECEIVED.

Rivers as Sources of Water Supply. By Dr. A. C. Houston. Pp. vi+96. (London: John Bale, Sons, and Danielsson, Ltd.) 5*s*. net.

The Origin of the World. By R. McMillan. Cheaper edition. Pp. xv+139. (London: Watts and Co.) 1*s*.

The Carnegie United Kingdom Trust. Report on the Physical Welfare of Mothers and Children. England and Wales. Vol. i., pp. xvi+434; vol. ii., pp. viii+190. (Dunfermline: Carnegie United Kingdom Trust.)

Text Book on Motor Car Engineering. By A. Graham Clark. Two vols. Vol. i., Construction. Pp. xix+437. Vol. ii., Design. Pp. xvi+368+21. (London: Constable and Co., Ltd.) Each 8*s*. 6*d*. net.

The Range of Electric Searchlight Projectors. By J. Rey. Translated by J. H. Johnson. Pp. xiv+152. (London: Constable and Co., Ltd.) 12*s*. 6*d*. net.

Contributions to Embryology. Vol. vi. Nos. 15–19. (Washington: Carnegie Institution.)

The Mosquitoes of North and Central America and the West Indies. By L. O. Howard, H. G. Dyar, and F. Knal. Vol. iv., Systematic Description. (In two parts.) Part ii. (Washington: Carnegie Institution.)

Lezioni di Antropologia. By Prof. F. F. Frassetto. Vol. iii. Pp. xiii+422. (Bologna: Libraria Mareggani.)

Ozone: Its Manufacture, Properties, and Uses. By Dr. A. Vosmaer. Pp. xii+197. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

The Aviator and the Weather Bureau. By Dr. F. A. Carpenter. Pp. 54. (San Diego: San Diego Chamber of Commerce.)

The Aviation Pocket-Book for 1917. By R. B. Matthews. Pp. xix+300. (London: Crosby Lockwood and Son.) 4*s*. 6*d*. net.

Higher Education and the War. By Prof. J. Burnet. Pp. x+238. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 10.

ROYAL SOCIETY, at 4.30.—Permanent Periodicity in Sunspots: Sir Joseph Larmor and N. Yamaga.—The High-frequency Resistance of Multiple-stranded Insulated Wire: Prof G. W. O Howe.

ROYAL INSTITUTION, at 3.—Pagan Religion at the Time of the Coming of Christianity: Prof. Gilbert Murray.

FRIDAY, MAY 11.

ROYAL INSTITUTION, at 5.30.—Radioactive Haloes: Prof. J. Joly.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Convection and Diffusion within Giant Stars. (2) Thermal Diffusion and the Stars: S. Chapman.—Observations of Ch. 7085 R.T. Cygni in 1912–17: A. N. Brown.—Solar Prominences, 1916: G. J. Newbegin.—Baxendell's Observations of Variable Stars, Ninth Instalment: H. H. Turner and Miss M. A. Blagg.

PHYSICAL SOCIETY.—Meeting postponed until May 25.

SATURDAY, MAY 12.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

TUESDAY, MAY 15.

ROYAL INSTITUTION, at 3.—Architectural Design in Organisms—The Laws of Growth and Form: Prof. D'Arcy Thompson.

ZOOLOGICAL SOCIETY, at 5.30.—Demonstration of the Behaviour of Living Birds and Mammals in the Presence of Snakes: Dr. P. Chalmers Mitchell.—Lantern Exhibition of Birds Now or Recently Living in the Society's Collection: D. Seth-Smith.

ROYAL STATISTICAL SOCIETY, at 5.15.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Annual Meeting.—*Discussion*: Economies in Lighting in Relation to Fuel Saving.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Estimation of Toluene in Crude Petroleum: S. E. Bowrey.

WEDNESDAY, MAY 16.

ROYAL SOCIETY OF ARTS, at 4.30.—The Blind Sufferers from the War, and their Future Employment: Sir C. Arthur Pearson, Bart.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Report on the Phenological Observations for 1916: J. E. Clark and H. B. Adames.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Exhibition of Microscopic Aquatic Life.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Configuration of Astronomical Masses and the Figure of the Earth.—J. H. Jeans.

ROYAL INSTITUTION, at 3.—The Chromosome Theory of Heredity and the Alternatives: Prof. W. Bateson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Future of Indian Trade with Russia: D. T. Chadwick.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual general meeting.

FRIDAY, MAY 18.

ROYAL INSTITUTION, at 5.30.—The Complexity of the Chemical Elements: Prof. F. Soddy.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Construction of Turbine-Pumps: A. E. L. Chorlton.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

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THURSDAY, MAY 17, 1917.

ELEVEN BRITISH MATHEMATICIANS.

Mathematical Monographs. No. 17. *Lectures on Ten British Mathematicians of the Nineteenth Century*. By Alexander MacFarlane. Pp. 148. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5*s*. 6*d*. net.

THE lives of mathematicians, as a rule, are free from sensational episodes, and provide no material for spicy biographies. But these unobtrusive beings form a quaint and varied set; and many people would be surprised to hear how many good stories are on record about their oddities, their accomplishments—nay, even their displays of wit.

The author of these lectures was himself a noteworthy man. A Highlander, and a pupil of Tait, he became an ardent quaternionist, and helped to found the International Association for Promoting the Study of Quaternions. Tait was a prejudiced and pugnacious champion of quaternions as against all other vector algebras, and he infected with his enthusiasm quite a considerable number of people. MacFarlane, in the land of Willard Gibbs, shook off most of this obsession, but there are traces of it even in these addresses, as on p. 45, where he says "most analysts are still crawling in Flatland," after a reference to Hamilton's application of quaternions to three-dimensional space. One might have thought this a place for some reference to Grassmann, whose calculus applies to space of any number of dimensions; not so, and although the index gives twenty-three references to Hamilton and fifteen to Tait, Grassmann is not so much as mentioned.

Apart from this blemish, the lectures deserve the warmest praise. In the first place, the list is truly representative, consisting of Peacock, De Morgan, Hamilton, Boole, Cayley, Clifford, H. J. S. Smith, Sylvester, Kirkman, and Todhunter. A few remarks may be offered on these worthies, each in his turn, and as each lecture suggests a reflection.

George Peacock will always be associated with the "principle of equivalent forms." As a principle it is as dead as a doornail, at any rate as it used to be appealed to; but, all the same, Peacock was one of the first to realise the general character of pure algebra as an abstract symbolism with more or less arbitrary fundamental rules. More than this, he was able, by his position at Cambridge, to make a vast improvement in the study of mathematics there. It was in his time that Leibniz's notation in the differential calculus obtained official recognition in England, partly owing to the efforts of the Analytical Society, "the object of which was stated to be to advocate the *d*'ism of the Continent versus the *dot*-age of the university." Peacock's "Examples" and "Symbolical Algebra" are still worth consulting, even apart from their historical interest.

The lecture on De Morgan is very good, but after our recent review of the reprint of the "Budget," we content ourselves with quoting his description of himself as *homo paucarum literarum*, apparently as a man who declined to be either F.R.S. or LL.D.[1]

As might be expected, the lecture on Rowan Hamilton is well-informed and appreciative, though the reference to his work in dynamics is meagre indeed as compared with the account of his calculus of quaternions. It may be noted that both Salmon and Cayley attended Hamilton's first course of lectures on quaternions.

George Boole, in some ways, is typically English. He may fairly be called the inventor of symbolic logic, and his work on the so-called symbolical method of solving differential equations is that of a pioneer. His predecessor is Peacock, and we may be proud to think that among his successors are Russell and Whitehead, even if the former, in a fit of just indignation, should become an American citizen. MacFarlane's comments on Boole's logical calculus are, technically, the weakest things in his course; on pp. 57–58 he shows that he has not appreciated the modern meaning of "class," and pp. 59–62 are simply "obfuscation," except to a man who cannot improve on the old Euler diagrams.

Cayley comes next, and the gem of the lecture is Clerk Maxwell's poem on the occasion of Cayley's portrait being presented; we cannot help quoting a stanza, if only to show that *some* mathematicians appreciate the witchery of words:—

> First, ye Determinants, in ordered row
> And massive columns ranged, before him go,
> To form a phalanx for his safe protection.
> Ye powers of the *n*th root of -1!
> Around his head in endless cycles run,
> As unembodied spirits of direction.

Cayley's presidential address to the British Association receives a proper amount of attention; oddly enough, Cayley either never read v. Staudt's "Geometrie der Lage" or did not appreciate it, for he seems to have died without realising an "imaginary point" as an actual geometric entity, although he did so much to found the projective theory of metrics. Cayley's kindness and courtesy and help to young mathematicians are duly recorded.

Clifford, owing to his early death, is an unsolved problem. All his mathematical work is brilliant, and, considering his years, original; but his philosophy was as bad as Herbert Spencer's, if not worse, and his cocksureness was irritating, even to his friends. But the author of "Commonsense of the Exact Sciences" deserves immortality, even though (or because) we agree with MacFarlane where he says: "The 'Phædo' of Plato is more satisfying to the mind than the 'Unseen Universe' of Tait and Stewart."

If we were asked to name the Admirable Crichton among British mathematicians, we

[1] And, we may add, who was accustomed to spell *littera* with one *t*.

should hesitate between Clerk Maxwell and H. J. S. Smith. Both are mathematicians of the first rank; both are cultured, witty, and childlike; one has all the virtues of the Irishman, the other all those of the Scot. Smith is the more elegant and careful writer; Maxwell is in closer contact with Nature, and possibly has done more to raise her mysterious veil. But Smith's very aloofness, his fondness for what "has no possible practical application," may only mean that he approached the sanctuary by a different road. Of his mordant wit the lecturer gives various samples; he even has the shameless audacity to quote: "—— sometimes forgets that he is only the editor, and not the author, of Nature." Smith's practical common sense, shown in dealing with university and college affairs, illustrates the fact that a mathematician is not always a nincompoop outside the range of his science.

Sylvester is one of the many Jews who have distinguished themselves as pure mathematicians. Self-conceited, irritable, careless as he was, he was eminently original, inspiring, and generous. His unbroken friendship with Cayley is no doubt mainly a credit to the latter, but it is very touching; and although Sylvester was not a model teacher he was stimulating, and had great influence on the best of his hearers. MacFarlane's account of him is, as it should be, both amusing and pathetic; it contains, among other things, Sylvester's brilliant retort to Huxley's depreciation of mathematics; this was one of the few cases in which Huxley was conclusively refuted.

The remaining two lectures are in some ways the most valuable of the ten, especially that on Kirkman. We wonder how many of our readers ever heard of Kirkman and his work; yet he was really a very brilliant mathematician, although comparatively unknown—partly from his own fault, partly from that of others. He used to send scores of ingenious problems to the *Educational Times* (many of them in doggerel verse); these would be quite worth looking up. Besides this, he did some very important work on the classification of polyhedra; the result was communicated to the Royal Society, and we are told here (p. 127) that only two of the twenty-one sections were published in the Philosophical Transactions. If this is true, it is little short of a scandal, and the rest of the MS. should be sent to Prof. Burnside, as the subject is closely connected with group-theory. We are also informed that there are papers on groups by Kirkman embedded in the Proceedings of the Manchester Philosophical Society [the R.S. subject index, p. 65, gives references to vols. i., iii., iv. (1862–65) and to vols. iv., v. of the later series (1891–92)]. Current English text-books on the subject give no reference to Kirkman at all; yet our lecturer says: "So far as British contributors are concerned, Kirkman was the first and still remains the greatest." Whether this is true or not, the matter requires investigation.

On p. 132 we have Kirkman's delightful paraphrase of Spencer's definition of evolution, and a reference to his work on knots; and on p. 133 his neat little problem:—

> Baby Tom of baby Hugh
> The nephew is and uncle too;
> In how many ways can this be true?

which we leave for our readers to solve. The lecture ends with a quotation from one of Kirkman's letters: "What I have done in helping busy Tait in knots is, like the much more difficult and extensive things I have done in polyhedra or groups, not at [all] likely to be talked about intelligently by people so long as I live. But it is a faint pleasure to think it will one day win a little praise."

All of us remember Todhunter as a coach and the author of text-books which in their time were thought the embodiment of perfection and are now unduly depreciated. But Todhunter was much more than a writer of text-books; his mathematical histories are deservedly accounted classics, and in them he was able to display his learning, accuracy, and acumen. We are very glad that a lecture was devoted to him, and that it is so sympathetic. Of course, we have the famous passage on experimental science, with its doctrine of taking everything on the word of "a clergyman of mature knowledge, recognised ability, and blameless character," but we have much more than that. Isaac had no ear for music, but he had a sort of dry humour of his own, as when he quotes the words of a Tripos candidate who was ploughed: "If there had been fairer examiners and better papers I should have passed; I knew many things that were not set."

The book ends with a quotation from Prof. (J. E. B.?) Mayor: "Todhunter had no enemies, for he neither coined nor circulated scandal; men of all sects and parties were at home with him, for he was many-sided enough to see good in everything. His friendship extended even to the lower creatures. The canaries always hung in his room, for he never forgot to see to their wants." May we all have as good an epitaph!

G. B. M.

THE FRESH-WATER FISHES OF RUSSIA.

Les Poissons des Eaux douces de la Russie. Par L. S. Berg. Pp. xxvii + 563 + 365 text-figures and a map. (Moscow: Department of Agriculture, 1916.)

PROF. BERG'S work on the fresh-water fishes of the Russian Empire, complete in one volume, will be welcomed by all ichthyologists, for the author's knowledge of Palæarctic fishes is unrivalled. In plan this work is more condensed than the very elaborate monograph ("Faune de la Russie: Poissons") on which Prof. Berg was engaged, and of which three parts had already appeared, when in 1914 he gave up the curatorship of fishes in the Imperial Academy of Sciences at Petrograd to become the first professor of ichthyology in the Academy of Agriculture at Moscow.

The book is written entirely in Russian, and

is evidently intended mainly for the author's countrymen, to whom an acquaintance with the fresh-water fishes is of considerable practical use, for the Russian fresh-water fisheries are very valuable. The true fresh-water fishes, indeed, are not of much account, but the migratory fishes, such as the salmon (quinnat, humpback, etc.) of the North Pacific, the char (Salvelinus) and whitefish (Coregonus) of the Arctic Ocean, the sturgeons, trout (*Salmo labrax*), and shad (Caspialosa) of the Black and Caspian Seas, are of great economic importance. The value of these anadromous fishes is due to two causes: first, they draw their food supply from the abundance of the sea and so are superior in size and numbers to the permanent inhabitants of the rivers, and, secondly, they concentrate at certain seasons to ascend the rivers to their breeding-grounds, when their capture in large quantities is easy enough.

An introductory chapter deals with structure and classification; this is up to date, and recent research on the morphology of the teleostean fishes is appreciated. In the systematic part of the work 281 species and about 100 sub-species are described, and the majority of them are figured; this is followed by a table illustrating in detail their geographical distribution, whilst a final chapter deals with the Palæarctic region and its division into sub-regions and provinces.

Prof. Berg recognises six sub-regions, Mediterranean, Arctic, Baikal, central Asiatic, Manchurian, and Chinese. In this classification considerable importance is attached to the anadromous fishes, and if these be neglected, and only the true fresh-water fishes, the bulk of which are Cyprinoids, be considered, a somewhat different result may be arrived at. The first three divisions might then be united to form a single sub-region, comprising Europe, with northern and western Asia; the fourth, the mountain region of central Asia, would stand; and the fifth and sixth might be added together to make an eastern sub-region, including the greater part of China, with Manchuria, Corea, and Japan. In each of the three areas just delimited the majority of the Cyprinoid genera and species are endemic.

The Manchurian (or Amurian) sub-region is established as transitional between the Arctic and Chinese sub-regions. A certain number of Siberian fishes occur in the Amur, but Chinese types are more numerous. The migratory Salmonidæ of the Okhotsk Sea also help to characterise this division. An interesting example of discontinuous distribution is the presence in the Amur of the European bitterling (*Rhodeus sericeus*), which is not found elsewhere east of the Volga.

Prof. Berg's Arctic and Mediterranean sub-regions are distinguished by the absence of certain Cyprinoids from the former, but chiefly by the difference between the anadromous fishes of the Arctic Ocean and those of the Black and Caspian Seas. This difference is of considerable interest in its bearing on the theory that the Caspian Sea was directly connected with the Arctic Ocean in comparatively recent times. The fish fauna of the Black Sea has two principal components: (1) an old Sarmatian fauna, also represented in the Caspian, and (2) recent immigrants from the Mediterranean, unrepresented in the Caspian. Similarly, the Caspian fishes have a double origin, including (1) genera or species that are peculiar to the Black and Caspian Seas, and (2) fresh-water species that have entered it from its tributaries and that live in those areas where the salinity is sufficiently low. The fishes give no support to the theory of a recent Arctic-Caspian connection, and there does not appear to be any definite geological evidence in its favour.

Lake Baikal has most of the true fresh-water fishes of the Yenisei, including a number of our most familiar British species, roach, dace, minnow, pike, perch, etc.; it also has a char and two Coregoni, relict forms of anadromous Arctic species; but the Baikal fish fauna is characterised by the presence of nearly a score of Cottidæ, which have found the vast area and great depths of the lake favourable to their evolution and have even given rise to a genus, Comephorus, which is generally regarded as the type of a distinct family. These Baikal Cottids seem to have come from an older and more primitive stock than the other Palæarctic species of the family, and they bear witness to the antiquity of the lake; but there is no evidence that they were directly of marine origin.

We are grateful to Prof. Berg for this fine volume; in its preparation he has studied a very complete material, comprising series of specimens from every lake and river in the Russian Empire, and the result is a work that is authoritative and of permanent value. C. T. R.

CHEMISTRY BOOKS FOR SCHOOL AND LABORATORY.

(1) *Text-book of Elementary Chemistry.* By Dr. F. Mollwo Perkin and Eleanor M. Jaggers. Pp. vii+384. (London: Constable and Co., Ltd., 1916.) Price 3s. net.

(2) *Elementary Practical Chemistry.* Part ii. By Prof. F. Clowes and J. Bernard Coleman. Eighth edition. Pp. xvi+255. (London: J. and A. Churchill, 1916.) Price 3s. 6d. net.

(3) *Technical Chemists' Handbook. Tables and Methods of Analysis for Manufacturers of Inorganic Chemical Products.* By Dr. George Lunge. Second edition, revised. Pp. xvi+264. (London: Gurney and Jackson, 1916.) Price 10s. 6d. net.

(4) *Chemistry for Rural Schools.* By E. Jones and A. Jones Griffith. Pp. 184. (London: Blackie and Son, Ltd., 1916.) Price 2s. 6d. net.

(5) *A Text-book of Quantitative Chemical Analysis.* By Drs. A. C. Cumming and S. A. Kay. Second edition. Pp. xv+402. (London: Gurney and Jackson, 1916.) Price 9s. net.

(1) ALMOST at the beginning of this little volume the student is directed to make an experiment, whereby he may find out for him-

self certain properties of chalk and gypsum. Experiment, in fact, is the keynote of the book. The authors teach mainly by experiment, and endeavour, as they put it, "to lead from fact to fact in an interesting and logical sequence." This setting of the student to "do things" straight away will awaken his interest, if anything will; and the experiments are well devised to make him absorb knowledge at his fingers' ends—the kind of knowledge which comes to stay. Quantitative experiments are introduced early in the course, and even though these are, sometimes, approximative only in the results, they have considerable educative value. No special syllabus has been followed, but the book treats of the inorganic substances usually included in an elementary course. A chapter on technical processes at the end, however, gives short accounts of some classes of carbon compounds—oils, soaps, coal-tar dyes, and perfumes; and this adds to the comprehensiveness of the volume. The description of the experiment with iron filings (p. 93) needs revision, as also does that with sodium chloride and silver nitrate (p. 233, fifth line from the bottom). Sulphuric acid, moreover, can scarcely act upon the *formula* of formic acid (p. 180).

(2) In this edition of Messrs. Clowes and Coleman's well-known work the subject-matter has been increased and rearranged. For the information of readers not familiar with the book it may be said that Part ii., now under notice, deals with elementary analytical chemistry, both qualitative and quantitative. It is arranged in four divisions. In the first, descriptions are given of the reactions of the commonly occurring metals and acid-radicles, together with methods for their detection. This portion includes the usual analytical tables, and forms the larger part of the book. Volumetric analysis is dealt with in the second division, and gravimetric determinations in the third. Acidimetry, alkalimetry, and determinations by means of oxidation, reduction, and precipitation operations are included in the volumetric processes; whilst in the gravimetric section the student is given exercises which initiate him into the methods of estimating the common metals and acids with the aid of the chemical balance. In the fourth and concluding division directions are given for the preparation of various classes of inorganic compounds by operations involving crystallisation, precipitation, sublimation, and distillation. The descriptions are lucid, and the information generally trustworthy; and no doubt the volume will continue to be a favourite text-book with students. In the ideal text-book, however, the student would not be told (p. 216) to "use 197·2" as the atomic weight of platinum for the purpose of correcting his results. Nor would the ideal text-book show quite so much small print, or be quite so economical of paper, as the present volume, even in war-time.

(3) Of Lunge's "Handbook" it must here suffice to say that it comprises tables of general chemical and physical data, such as molecular weights, specific gravities, and vapour densities, together with analytical methods used for the control of the operations in various chemical industries, including the manufacture of sulphuric acid, alkali, ammonia, coal-gas, and cement. In the new edition the analytical factors have been recalculated on the basis of the international atomic weights for 1916, and the tables of specific gravities have been revised, checked, and extended. The author's name is a guarantee that the data are trustworthy and the methods judiciously selected.

(4) Is there any reason why an elementary treatise on chemistry written "for rural schools" should differ from the ordinary run of text-books on the subject? The authors think there is, inasmuch as for such a treatise examples can be taken from the farm, the garden, and the dairy to illustrate chemical principles. Thus the science can be brought more directly home to the students, and they are helped both to apply their knowledge to farm work and the better to comprehend agricultural literature. Copper sulphate, for instance, is not treated merely as a collection of blue crystals to be shown on the lecture-table. To the authors' students it is the fungicide sprayed in cornfields to kill charlock; it is the remedy for foot-rot in sheep; it is the chief ingredient of the Bordeaux mixture used for spraying potatoes. These facts invest the "blue stone," which the rural student is directed to prepare from copper and sulphuric acid, with a very real interest for him. In pursuance of this idea the illustrative examples in the text are drawn from agriculture rather than from manufactures. To make the book serve not only as a foundation for the study of pure chemistry, but also as an introduction to agricultural chemistry, the authors have included chapters on assimilation by plants, on proteins and animal nutrition, on fermentation, and on the constituents of soil. The collections of questions provided are a useful feature, and the book will be found very serviceable in rural schools.

(5) Messrs. Cumming and Kay's volume has been revised in this, the second, edition, and additional methods of analysis have been included. It is intended for university and college students, for whom it provides a very satisfactory introduction to the various branches of quantitative chemical analysis. The experiments described include simple electrolytic processes, gas analysis, and molecular-weight determinations, as well as the ordinary volumetric and gravimetric estimations. The authors rightly emphasise the educative value of volumetric methods, and point out the desirability of accustoming the student, from the commencement, to the examination of substances the composition of which is unknown to him. The directions they give are clear and precise; the examples are well chosen; and everything is done to inculcate cleanliness and accuracy in manipulation. As an introduction to the art and mystery of finding out "how much" of a substance the experimenter is dealing with, and of doing it with precision, this book can be unreservedly recommended.

C. S.

OUR BOOKSHELF.

Science Française—Scolastique Allemande. Par Prof. G. Papillault. Pp. iv+154. (Paris: Librairie Félix Alcan, 1917.) Price 2.50 fr.

THIS volume is one of the well-known series "Bibliothèque de Philosophie contemporaine," and the author is professor of sociology at the School of Anthropology of Paris. There has been a great mass of literature that is inspired by a form of patriotism, published in France and over here, on the defects of German character and the incompetence of the Germans in science, so that it is a relief to have the author's assurance (p. 3) that this is not the case with his book. His object is to estimate scientifically the value of German thought as shown in its principal philosophical systems and in its most evident general tendencies. The methods used are two: one is to regard a philosophy as an effect of psycho-social causes, and the other is to regard it as a cause. It is impossible not to feel that regarding Kant or Hegel or Nietzsche as a cause of the ideals of the State current in Germany is somewhat of the nature of wisdom—if it is wisdom—after the event. In this book it is Kant who comes in for blame.

The second part of the book deals with the sophisms made by the rational instincts, chiefly of Germans, and the third part is a comparison of the great philosophical systems with scientific and sophistical methods. German thought is, we hear, "scholastic" and "sterile"; certain rather inferior Germans used to say very much the same thing about what was too subtle for them. φ

The Chemists' Year Book, 1917. Edited by F. W. Atack, assisted by L. Whinyates. In 2 vols. Pp. 1030. (London and Manchester: Sherratt and Hughes, 1917.) Price 10*s.* 6*d.* net.

THE general character of the contents of these excellent volumes was described in the review of the 1916 issue published in NATURE for June 15 last (vol. xcvii., p. 320). In the present edition, in addition to general revision, the sections on gas analysis, sulphuric acid, oils and fats, fuels and illuminants, and photography have been thoroughly revised; and that on textile fibres has been rewritten. New sections have been added on the analysis of essential oils, the efficiency of boiler plant, cement, and paints and pigments. It is hoped in next year's issue of the Year Book to include articles on ceramics, lubricants, and metallurgy and metallography, which had unavoidably to be held over this year.

The thorough editorial work has well maintained the trustworthiness and up-to-date character of this comprehensive compilation.

X-rays. By Dr. G. W. C. Kaye. Second edition. Pp. xxii+285. (London: Longmans, Green and Co., 1917.) Price 9*s.* net.

THE first edition of Dr. Kaye's book was reviewed in the issue of NATURE for March 25, 1915 (vol. xcv., p. 87); and it will be enough to say of the new edition that, so far as his military duties have permitted, the author, who now ranks as a captain in the Royal Engineers (T.), has thoroughly revised the text and incorporated all important original work published up to June of last year. An additional chapter on X-ray equipment and technique by Mr. W. F. Higgins has been incorporated.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Classical Education and Modern Needs.

IN his reply to Mr. Livingstone's letter in NATURE of May 10 Mr. Wells makes a point which classical apologists, especially those who have not had experience in teaching boys, seem incapable of grasping. Mr. Livingstone, on his own showing, would seem to have fallen into a like error. For more than twenty years it has been my lot to teach science to boys, most of whom are graded on their proficiency in linguistic studies, chiefly Latin and Greek. Experience has convinced me that it is a fundamental mistake to suppose that boys even of fifteen or sixteen show marked taste or ability for science or mechanics as opposed to linguistics, or *vice versa.* Those that do are the exceptions that prove the rule.

The boys who are best at classics are also best at science. It is a question of general ability and nothing more. The fallacy that success in, or aptitude for, science denotes the possession of a special kind of intelligence, rarely forthcoming, but always clearly marked at an early age where it does exist, needs uprooting now and for ever; its prevalence is widespread, and the mischief it has done is great.

Every intelligent boy must be given equal opportunities in science and languages in the widest sense of the word, until he is old enough to show which line of study he can most profitably follow. Until this is done, and while only those boys who show a want of literary faculties are encouraged to "take up science," so long will the best brains of our rising generation be imperfectly trained, and the potentialities of the nation towards achievement in science stunted and handicapped. M. D. HILL.

Eton College, Windsor, May 13.

Aeroplanes and Atmospheric Gustiness.

THE invitation of Prof. McAdie to readers of NATURE (April 12, p. 125), to offer suggestions on the above subject, is one to which I, for one, am very glad indeed to respond, although I may not be able to add much of value to what has already been said in previous writings regarding gusts.

It is a common matter of agreement, I think, that the gust condition is associated, not with mere velocity of the air—which is already identified with the idea of wind—but with *changing* velocity of the air. The simplest record of that, and so, on this view, of the gust, seems to be the instantaneous acceleration of the air, moment after moment Accordingly I would suggest that continuous observatory records of gustiness might already be obtained, by first obtaining ordinary anemograph records of the wind, with time scales open enough to show distinctly whole seconds; and by then graphically differentiating such records

at every ordinate, so as to provide the data for drawing what I will call, for brevity in reference, the "gustograph" record. That something in the way of truth has then been obtained appears from the reflection that a man who had the air acceleration under his control for a given five minutes and a gustograph or acceleration record for some previous five minutes, would be able to reproduce the gusty phenomena of the air for that previous five minutes by controlling the air acceleration according to the gustograph record. He would not, of course, necessarily reproduce the actual *wind* of the previous five minutes, unless he happened to *start* the five-minute reproduction with the right wind value, but that agrees entirely, I believe, with the distinction there is between gustiness and wind in connection with aircraft.

As regards the safe "flyability" of the air by aircraft, I hazard the guess that it may be found convenient to connect it with such a quantity as the *maximum* gust over a random minute run of the gustograph, or perhaps with the *average* gust over the same period.

The proposal Prof. McAdie mentions—using the exponent of an exponential equation as the measure of the sharpness of a gust—looks easier to apply in examining the influence of particular classes of gusts than in obtaining continuous records from instant to instant. For the latter purpose it is, I submit, desirable that the gust should be defined by instantaneous conditions, independently of knowledge of things at a finite time either before or after the given instant. I may, however, be misunderstanding the exponential proposal in this connection.

If principles like those I suggest found acceptance, the question of having standard gustograph instruments would soon be likely to arise; for graphical differentiation of anemograph records is tedious, and discouraging to progress. I think gustographs may be designed on two broad principles: in the first there is an anemometer in which the *rate of change* of the reading is continuously recorded, and in the second there is an arrangement of fans and flywheels with torque-recording couplings between.

I shall be very pleased if what I have written contributes to the discussion anything which needed, in any case, to be brought under consideration.

S. L. WALKDEN.

London, N., April 25.

The Preparation of "Blood Charcoal."

PURE "blood charcoal" is a reagent of considerable importance to the physiological chemist. It is not only required for the decolorisation of liquids, but also for selective adsorption in an important series of quantitative estimations of animal fluids.

My stock of Merck's blood charcoal is nearly exhausted, and I cannot obtain a supply of any home-made article that is suitable.

I should be most grateful if any of your readers could give me any information as to the method of preparation of blood charcoal, or the name of a firm that would be willing to manufacture and supply the article. Material as good as Merck's would command a ready sale at home as well as in America, where they have had to abandon rapid and accurate methods of analysis owing to the lack of the necessary charcoal. Folin states, in a recent number of the *Biochemical Journal*, that no other charcoal will adsorb creatinine. I have got perfect results with two other specimens of charcoal, but inquiry reveals the fact that both of them came originally from Germany. Surely our technical chemists can produce articles as good as those of the Germans. SYDNEY W. COLE.

Biochemical Laboratory, Cambridge, May 9.

STUDIES IN GENETICS.[1]

(1) PROF. CASTLE was fortunate enough to secure in Peru a number of specimens of a wild species of guinea-pig, *Cavia cutleri*, Bennett, which is the probable ancestor of the numerous domesticated races which have had their origin in that country and have been introduced elsewhere. He found that this wild species produced completely fertile hybrids when crossed with various races of domesticated guinea-pigs, and the results of the hybridising experiments go to show that all the domesticated colour-varieties have arisen from *C. cutleri* by loss-variation or loss-mutation. It does not follow, however, that wild species have arisen in this way, as some believe, for it is significant that the Brazilian wild species, *C. rufescens*, yields sterile hybrid males when crossed with the domesticated varieties, while similar crosses between *C. cutleri* and domesticated varieties yield completely fertile hybrids. One of the general results of Prof. Castle's hybridisation experiments is to confirm his previous conclusion that size inheritance is blending and does not mendelise. It is not denied, however, that in special cases mendelising factors may exist that affect size.

In another study Mr. Sewall Wright deals with the genetic factors determining coloration in guinea-pigs and with the conditions which may account for continuous series of variations. "Intermediates between varieties which mendelise regularly have been found to follow very definite modes of inheritance, which, however, are very different in different cases, and could not possibly be predicted *a priori*." He shows that a complex of the most varied causes may underlie an apparently simple continuous series of variations.

Of great interest, again, are the prolonged breeding experiments that Prof. Castle has made with hooded rats. It is shown that the factor for hooded colour pattern may vary in genetic value. There may be genotypic variation in grade as well as phenotypic fluctuation—a conclusion which brings us back to a familiar Darwinian doctrine. "Racial changes," Prof. Castle writes, "may be effected through selection by the isolation of genetic fluctuations, as well as by the isolation of mutations. Moreover, genetic fluctuation makes possible *progressive change* in a particular direction, repeated selection attaining results which it would be quite hopeless to seek by any other means." The study of the hooded rats, previously reported on by Castle and Philipps in 1914, has been carried through three or four additional generations. "The additional genera-

[1] (1) "Studies of Inheritance in Guinea-pigs and Rats." By W. E. Castle and Sewall Wright. Pp. 192+7 plates. Carnegie Institution of Washington, Publication No. 241 (1916).
(2) "Gonadectomy in relation to the Secondary Sexual Characters of some Domestic Birds." By H. D. Goodale. Pp. 52+7 plates. *Ibid.*, Publication No. 243 (1916).
(3) "The Jukes in 1915." By A. H. Estabrook. Pp. vii+85+26 charts. *Ibid.*, Publication No. 240 (1916).
(4) "Fecundity *versus* Civilisation: A Contribution to the Study of Overpopulation as the Cause of War and the Chief Obstacle to the Emancipation of Women. With Especial Reference to Germany." By Adelyne More. With an Introduction by Arnold Bennett. Pp. 52. (London: G. Allen and Unwin, Ltd., 1916.) Price 6*d*. net.

tions of selection show a continued progressive movement of the racial character in the direction of the selection, and indicate the existence of no natural limit to the progress which selection can make in changing the hooded character." Prof. Castle's experiments show that there has been over-hastiness in generalising from the results reached by Johannsen and others.

(2) The influence of the reproductive organs on the secondary sex-characters differs in different groups of animals. A male crab that has suffered parasitic castration puts on a number of feminine characters and develops a small ovary. In insects, on the other hand, the secondary sex-characters seem to be quite independent of the gonads. In male mammals the castration may not be followed by any marked peculiarity in the development of the secondary sex-characters, though some of them may remain in an arrested infantile condition. In the female mammal the removal of the ovaries has very little effect on the secondary sex-characters. What Mr. Goodale has shown in regard to female birds (ducks and hens) is just the opposite of what holds in mammals. If the ovary be completely removed the female puts on the secondary sex-characters of the male—sometimes with startling completeness. Some individuals, as the fine coloured plates show, become nearly perfect replicas of the male; others are imperfectly masculine. It is interesting to notice that the masculine characters induced on the ovariotomised female are always like those of the male of the same breed. With male birds the case is different. If the gonads be removed, the majority of the secondary sex-characters of the male develop, though a few may remain in an infantile condition. What have been sometimes called feminine characters in castrated or abnormal males almost always turn out to be juvenile characters. Another interesting general fact is that castrated drakes lose the power of developing the summer plumage.

In thinking of the results of this carefully worked-out piece of experimental investigation, we see clearly that the internal secretions of the gonads have a specific morphogenetic influence on growing or active cells of the body. As Mr. Goodale says, the secretions must be considered part of the influential environment of each cell. But the further question arises whether the secretion acts as a "modifier" affecting the factors of a feminine character so that the result in development is a masculine character; or whether the secretion acts as an "inhibitor" on one of two alternative groups of factors, respectively masculine and feminine, both present in the female's genetic constitution. Thus in the duck or hen the ovarian secretion inhibits the developmental expression of the masculine plumage; in the absence of the secretion the masculine features find expression. It is too soon to decide between these views; Mr. Goodale appears to incline to the former. It may be noticed incidentally that there is no conclusiveness in Mr. Goodale's argument against Darwin's theory of sexual selection. "According to Darwin's theory the start was made from a dull-coloured monomorphic species, an assumption that is not in accord with the nature of the female as shown by castration, since the brilliant male colours are only suppressed in her. The only possible effect of selection, then, would be the uncovering of a condition already present. But, by hypothesis, this condition did not pre-exist." But it is impossible to argue from the constitution of a Rouen duck of 1916 to what may have been the constitution of the female of distant ancestral types, before masculine mutations—probably enough arising in male-producing gametes—began to be included in the common complement of hereditary factors, forming a contingent of characters that normally lie latent in female soil, and are normally patent in male soil.

(3) Nearly a century and a half ago there drifted into an isolated valley in Z county in the United States "a number of persons whose constitution did not fit them for participation in a highly organised society." Much of the original stock was unsound, and in the relaxation of a primitive environment many of their progeny went from bad to worse. Constant inbreeding accentuated the deterioration. In 1874 the close blood-relationship of a number of criminal types in the area referred to attracted the attention of Mr. R. L. Dugdale, an Englishman settled in New York, who was keenly interested in questions of social reform. In 1877 he published his well-known study, "The Jukes," in which he showed that a bad inheritance associated with deteriorative environmental conditions had resulted in a deplorable multiplication of criminality, harlotry, and pauperism. The names he used in his investigation were fictitious, but the chance discovery of his original manuscript has made it possible for Dr. A. H. Estabrook to follow the later history of the strains which Dugdale studied. Starting from five sisters 130 years ago, the Jukes have become 2094, of whom 1258 were living in 1915. "One-half of the Jukes were and are feeble-minded, mentally incapable of responding normally to the expectations of society, brought up under faulty environmental conditions which they consider normal, satisfied with the fulfilment of natural passions and desires, and with no ambitions or ideals in life. The other half, perhaps normal mentally and emotionally, has become socially adequate or inadequate, depending on the chance of the individual reaching or failing to reach an environment which would mould and stimulate his inherited social traits." It must be noted that some have become good citizens.

Dr. Estabrook's study shows that cousin-matings of defective stock result in defective offspring; that there is an hereditary factor in licentiousness; that pauperism indicates physical or mental weakness; that all the Juke criminals were feeble-minded; that penal institutions have little beneficial influence upon these; and that ameliorative environment has markedly improved

a certain number of the individual members of the stock. The investigator has worked with patience and carefulness; his most feasible practical suggestion is the permanent custodial care of the feeble-minded Jukes.

(4) In a clear and courageous essay Adelyne More points out the advantages of a deliberate reduction of the birth-rate. Only thus can women secure independence; it is the chief way of reducing infantile mortality; it is the only way by which struggling parents can attain economic security; it forms part of the prophylaxis against venereal disease; and it is the most effective way of ensuring the cessation of war. "An undue fecundity promotes international pugnacity of precisely the kind which was operative in bringing about the present war." In a slashing preface—admirable in its exposure of our Anglo-Saxon false shame—Mr. Arnold Bennett deals, somewhat too cavalierly, we think, with the hygienic, religious, political, and industrial arguments against the use of contraceptives. He does not consider the ethical difficulties—perhaps transitional, but already real enough—involved in being able at will to evade the natural consequences of sexual intercourse, nor the social difficulties involved in the unequal birth-rate in different sections of the community, and in the likelihood that birth-control would tend to be adopted most among thrifty, far-sighted, controlled, and "individuated" types, of whom a progressive nation wishes more, not fewer. J. A. T.

ENGINEERING EXPERIMENT STATIONS.

A MEMORANDUM prepared for the Governor and the General Assembly of the State of Illinois, concerning the work of the College of Engineering and the Engineering Experiment Station of the University of Illinois, has lately reached us. It is partly a statement of the work of the college, which gives degrees to more than 200 engineering students annually, with photographs of some of the large engineering works executed under the direction of its graduates, and partly an appeal for a large extension of its buildings. It is pointed out that the growth of a State in population, wealth, and influence depends chiefly on its success in the development of engineering industries.

It is known that the "State universities" of the United States have engineering laboratories more largely staffed and more completely equipped than those in this country, and that they carry on research work very directly associated with industrial needs. Lately there has been a movement to develop these as "experiment stations." In the case of the Illinois University the control is vested in the heads of departments of the college; the ordinary equipment of the laboratory is used, but there are nine investigators devoted to research work and fourteen research fellows who give half-time to research. All results are published and 106 bulletins have been issued.

In a short account of the more important researches carried on, it is stated that Prof. Talbot's tests of reinforced concrete have supplied information on which standard practice has been based. They are well known in this country. In the case of iron alloys, researches have been made with an electric furnace permitting melting *in vacuo*. These, it is claimed, have led to the production of iron alloys having magnetic properties far superior to anything hitherto known—for example, specimens with a permeability seven or eight times higher than any other alloy. A new law bearing on steam-engine practice has been discovered by Mr. Clayton, connecting the form of the indicator expansion curve with the quality of steam in the cylinder. This makes it possible to predict the economic performance of an engine from the evidence of the indicator diagram. Prof. Goodenough has deduced values of the constants for steam which, it is stated, give the means of calculating steam tables of far greater accuracy than any hitherto published. Prof. Parr has devised a new low-temperature process of carbonisation of the non-coking Illinois coal of great importance, with the advantage that valuable by-products are recovered.

The building programme put forward will involve an expenditure of nearly 1,000,000*l.*, exclusive of land and equipment. In the last two years the expenditure of the college has been 152,000*l.*, and the budget for the next two years is 300,000*l.* Some account is given of the Massachusetts Institute of Technology, now incorporated with Harvard University, which has purchased land and erected buildings and provided equipment at a cost of 1,400,000*l.*

The most important experiment station in the United States is, no doubt, the Bureau of Standards—a Federal institution which has relations with many industries, and receives from the Government 125,000*l.* annually. A remarkable development is the Mellon Institute attached to the University of Pittsburgh. There any industry can endow a fellowship for a specific research. The University selects a suitable investigator and provides the laboratory. When results are obtained a small unit factory is established near the institute and the process worked on a small but commercial scale. The annual expenditure is 30,000*l.*

PROF. EMIL VON BEHRING.

IN NATURE of April 26 a short chronological survey was given of the career of Emil von Behring, whose death was recently announced. In the early eighties of last century, whilst a military surgeon at Bonn, Behring commenced a series of investigations which ultimately led him to the discovery of anti-toxins. This work merits fuller notice than could be given to it within the limits of a paragraph in the Notes columns of NATURE.

The fact that white rats were generally immune against anthrax, whereas ordinary wild

rats were susceptible to the disease, had excited the curiosity of bacteriologists. With the view of discovering the cause of the resistance of white rats, Behring tried the effect of their serum upon anthrax bacilli *in vitro*, and found that anthrax bacilli were killed by a short sojourn in fresh serum. This observation, together with those of Nuttall upon the similar properties of the fresh serum of man and several animals, formed the foundation of the humoral theory of defence against the invasion of microbes into the animal body.

In 1888 Behring went to Berlin and became an assistant to Koch at the Hygienic Institute. There he was associated with Loeffler and Kitasato, who had recently discovered the microbes causing diphtheria and tetanus respectively, diseases apparently brought about by the local multiplication of the organisms and without the penetration of the bacilli into the body generally. These were important steps in the interpretation of zymotic disease, and indicated that microbes manufactured soluble poisons which, being absorbed, acted upon the cells of the nervous system and other essential organs. The demonstration of the accuracy of this interpretation followed in 1888 when Roux and Yersin grew diphtheria bacilli in broth, removed the bacteria by filtration through unglazed porcelain, and produced the characteristic effects of diphtheria with the sterile filtrate. To this bacillary poison they gave the name "toxin."

Following up his earlier researches, Behring, by repeated small inoculations of certain microbes, immunised animals against large doses, and showed that their serum possessed the property of destroying *in vitro*, in an enhanced degree, the microbes to which they had been accustomed.

The psychological moment for the discovery of anti-toxic immunity had now arrived, and in 1890 Behring and Kitasato announced the discovery that an animal, immunised against tetanus and diphtheria by graduated injections of killed broth cultures of these microbes, produces in its blood substances which are capable of neutralising the toxic actions of these bacteria. They also showed that an animal previously injected with the serum of such an immunised animal withstood an otherwise fatal dose of bacilli or toxin, and, further, that when treated with the serum, even after symptoms had developed, it could be cured. To the substance in the serum of immunised animals they gave the name "anti-toxin." These fundamental observations were carried a stage further by Behring and Baer, and the serum tested on children with favourable results.

The importance of the initial discovery by Behring and Kitasato was at once seized by Emil Roux, the present director of the Pasteur Institute, who, in collaboration with Louis Martin, developed a method for its practical application which has been changed in little else than detail up to the present day. They immunised horses and were thus able to produce anti-toxic serum in quantity. In collaboration with their colleagues at the Paris hospitals, a trial of the new remedy was made in such a manner and upon such a scale as to place the serum treatment of diphtheria upon a firm basis by 1894.

During the last twelve years Behring's scientific activity had been for the most part directed to the problems of the immunisation against and cure of tuberculosis in man and animals. Behring started with three theses. The first is that the bacilli of human and bovine tuberculosis are but varieties of the same organism; the second is that infection, in the case of both man and animals, takes place in early life *via* the alimentary canal, and that phthisis is a sequel to such intestinal infection; and the third is that few humans or bovines escape infection before becoming adult. The first and second of these views, although receiving support in some quarters, have not been generally accepted, and the assertiveness, unsupported by evidence, with which they have been expounded by their author has not conduced to their receiving even so much attention as they deserve. Assuming their correctness, however, it is obvious that prophylactic immunisation, if it is to be effective, must be undertaken in early life. Behring attempted this with cattle, using attenuated human tubercle bacilli, but the results were not commensurate with expectations.

The treatment of children with any form of living tubercle bacilli being impracticable, Behring endeavoured to prepare extracts of killed bacilli which might possess the desired properties. The difficulties of inquiries in this domain, and their possible value to humanity, can scarcely be exaggerated, and it is a matter for regret that Behring's efforts therein should have been shrouded in a certain mysteriousness which is inimical to the best interests of science. A product of tubercle bacilli called "tulase" was evolved, which, according to the author, immunised animals against living tubercle bacilli and was effective in the treatment of tuberculosis in man. The exact nature and methods of preparation of tulase have not been made known beyond the statement that it is produced by the prolonged action of chloral hydrate upon tubercle bacilli, and is different from tuberculin. As, however, no results of this remedy have been forthcoming, and as several years have passed since it was introduced, it has presumably proved disappointing.

From 1895 until shortly before his death Behring was professor of hygiene in the University of Marburg, and director of the Hygienic Institute. For his discovery of anti-toxin he was awarded in 1895 the prize of the Académie de Médecine and Institut de France, and he had many distinctions conferred upon him by learned societies. In 1901 he received the patent of nobility, and in the same year was awarded the Nobel prize.

C. J. M.

NOTES.

A FAMOUS American, who did much to promote friendly relations between Great Britain and the United States, died in New York on Tuesday, May 15, in the person of Mr. J. H. Choate, United States Ambassador to Great Britain from 1899 to 1905. His eloquence and his influence during this term of office made enduring impressions upon the British people, who will always associate him with Anglo-American goodwill. Mr. Choate was a trustee of the American Museum of Natural History, and a member of the American Philosophical Society. Honorary degrees were conferred upon him by many universities, among them being Edinburgh and Cambridge (1900), Oxford and St. Andrews (1902), and Glasgow (1904).

THE death is announced, at seventy-four years of age, of Prof. L. J. Landouzy, professor of clinical medicine in the University of Paris, and author of "Les Sérothérapies" and many other works.

ANNOUNCEMENT has been made already of the decision of the council of the British Association not to hold the usual annual meeting this year, on account of travelling restrictions and difficulties of accommodation at Bournemouth, caused by conditions of war. It is necessary, however, to hold a formal meeting in order to bridge over the gap between the meeting at Newcastle-upon-Tyne last year and that which it is hoped to hold at Cardiff in 1918. Arrangements have been made, therefore, for meetings of the council of the association, the General Committee, and the Committee of Recommendations to be held in London on Friday, July 6, in order to make appointments, receive the report of the council for the year, and transact other necessary business.

A FEW days ago a correspondent of the *Daily Mail* resuscitated a well-known quotation from George Gissing's "Private Papers of Henry Ryecroft," in order to associate science with the horrors of the present war. The words are as follows:—"I hate and fear 'science' because of my conviction that, for long to come, if not for ever, it will be the remorseless enemy of mankind. I see it destroying all simplicity and gentleness of life, all the beauty of the world; I see it restoring barbarism under the mask of civilisation; I see it darkening men's minds and hardening their hearts; I see it bringing a time of vast conflicts, which will pale into insignificance 'the thousand wars of old,' and, as likely as not, will whelm all the laborious advances of mankind in blood-drenched chaos." We have on several occasions pointed out that it is merely pandering to popular prejudice to make science responsible for German barbarity or for the use of its discoveries in destructive warfare. Chlorine was used as a bleaching agent for much more than a century before the Germans first employed it as a poison gas; chloroform is a daily blessing to suffering humanity, but it is also used for criminal purposes; potassium cyanide may be used as a poison or to extract precious metals from their ores; and so with other scientific knowledge—it can be made a blessing or a means of debasement. The terrible sacrifice of human life which we are now witnessing is a consequence of the fact that the teaching of moral responsibility has not kept pace with the progress of science. As in medieval times all new knowledge was regarded as of diabolic origin, so even now the popular mind is ever ready to accept such views of the influence of science as are expressed in Gissing's work. The pity of it is that the public Press does nothing to dispel illusions of this kind by urging that what is wanted is not less scientific knowledge, but a higher sense of human responsibility in the use of the forces discovered.

MR. HAROLD FIELDING-HALL, who died on May 5, was a coffee-planter in Burma, and later a distinguished political officer in that province. He was an ardent student of Buddhism from the idealistic point of view, and his chief work, "The Soul of a People," did much to encourage the study of Buddhism in Europe and America. But, in the opinion of practical observers, its tendency was to ignore the popular and less admirable development of the faith in the East, while insisting on the value of its philosophical aspects.

THE Government Central Control Board has appointed an advisory committee, consisting of Lord D'Abernon (chairman), Sir G. Newman, Dr. A. R. Cushny, Dr. H. H. Dale, Dr. M. Greenwood, jun., Dr. W. McDougall, Dr. F. W. Mott, Dr. C. S. Sherrington, and Dr. W. C. Sullivan, to consider the conditions affecting the physiological action of alcohol, particularly the effects on health and industrial efficiency produced by the consumption of beverages of various alcoholic strengths, with special reference to the recent orders of the Central Control Board, and further to plan out and direct such investigations as may appear desirable with the view of obtaining more exact data on this and cognate questions.

AT the general meeting of the members of the Royal Institution on May 7 a letter was read from the distinguished mathematician, M. Paul Painlevé, the French Minister of War. After thanking the members for electing him an honorary member of the Royal Institution, an honour which has been conferred on few Frenchmen, M. Painlevé went on to say:—"Ce qui me fait, ensuite et surtout, attacher un prix particulier à l'honneur d'avoir été choisi par vous pour faire partie de votre Assemblée, c'est que ce choix s'est manifesté en pleine guerre alors que nos deux pays combattent côte à côte le combat du droit. Puissent ainsi toutes les forces intellectuelles et toutes les ressources scientifiques de l'Angleterre et de la France hâter la victoire de nos armes et assurer pour jamais dans le monde la suprématie de la pensée sur la violence."

THE seventh annual report of the Illuminating Engineering Society was presented at the annual meeting on May 15. The society, dealing with scientific and industrial aspects of a wide subject, unites on common ground electrical engineers, gas engineers, manufacturers of lamps and shades, physicists, ophthalmic specialists, architects, and surveyors. This branch of engineering has been recognised by the appointment, under the Department of Scientific and Industrial Research, of a Joint Committee on Illuminating Engineering. The successful union of these various interests is largely due to the efforts of the hon. secretary, Mr. Leon Gaster, during the last ten years. Mr. Gaster is a British subject of Rumanian origin, and is thus doubly associated with the cause of the Allies. All the male members of his family in Rumania and in England who are of military age are fighting for this cause, and one of his nephews was recently killed in Rumania.

CONSIDERABLE progress has, we learn, been made with the proposal to establish a national memorial to the late Capt. F. C. Selous, D.S.O., who, it will be recalled, was killed in action while leading his men in an attack on a German post in East Africa early in January last. An influential and representative committee has been formed under the chairmanship of the Rt. Hon. E. S. Montagu, M.P., with Mr. E. North Buxton and the Hon. W. P. Schreiner, C.M.G., as vice-chairmen. Among others who have joined the committee are Viscount Buxton, G.C.M.G., the Earl of Coven-

try, Dr. David (Headmaster of Rugby), Lord Desborough, K.C.V.O., Viscount Grey of Fallodon, K.G., Col. T. Roosevelt, Lt.-Gen. J. C. Smuts, and representatives of the Royal Geographical Society, the Zoological Society, the Entomological Society, the British Ornithologists' Union, the Royal Colonial Institute, and the British South Africa Company. The committee has decided, with the permission of the trustees of the British Museum, to place a mural tablet in the Natural History Museum, where many of Selous's finest trophies are exhibited, but the very encouraging response which has been received to the proposal for a national memorial of the great hunter, explorer, and naturalist indicates that there is a general desire that some additional form of perpetuating his memory should be established. Several suggestions have been considered, and it is hoped that at least it will be possible to found a Selous scholarship at Rugby (his old school), for the sons of officers, primarily of those who have fallen in the war. The hon. secretary to the Memorial Committee is Mr. E. Stuart Baker, 6 Harold Road, Norwood. Subscriptions should be sent to Mr. C. E. Fagan, hon. treasurer, Selous Memorial, Natural History Museum, South Kensington, London, S.W.7.

WE learn with regret that on April 30 Arnold Lockhart Fletcher died in a Red Cross hospital at Rouen of wounds received some days earlier at the front. Prof. J. Joly writes:—Arnold Fletcher was born in 1889. He was a graduate of Trinity College, Dublin, and obtained the degree in civil engineering in 1909. Shortly afterwards he was appointed research assistant in the department of geology and mineralogy in Trinity College. In 1910 he took part in communicating a paper on "Pleochroic Haloes" to the *Philosophical Magazine*. In the same year he commenced work on the radium content of rocks. He dealt successively with the rocks of the Transandine tunnel (*Phil. Mag.*, July, 1910) and with the Leinster Granite (*Phil. Mag.*, January, 1911). In the latter materials he also made determinations of thorium content. He directed special attention to the remarkably uniform ratio between the quantities of the two radio-active families present, a peculiarity since noticed in other cases. The Antarctic rocks followed (*Phil. Mag.*, June, 1911). Finally, he undertook a very complete examination of the secondary rocks (*Phil. Mag.*, February, 1912). In this research the fusion method was used, and the utmost care taken to eliminate errors. This work is entitled to rank as the best that has been done on these materials. Fletcher contributed a paper on sublimates, obtained at high temperatures, to the Royal Dublin Society in 1913. In the same year an account of a method of finding the radium content of radium-rich minerals by fusion on a carbon hob appeared in the *Phil. Mag.* This last work was done in the Royal College of Science for Ireland. In 1913 Fletcher entered the service of the Irish Department of Agriculture and Technical Instruction as inspector, an institution of which his father—Mr. George Fletcher—is assistant secretary in respect of technical instruction. Shortly after the war broke out Arnold Fletcher applied for a commission, and was gazetted in the Leinster Regiment in April, 1915. At the time of his death he was attached to a machine-gun corps. Fletcher possessed qualities which contribute to success in scientific work: patience, enthusiasm, manipulative skill, determination, and the power of overcoming experimental difficulties. In his brief life he did work which must find permanent record among the data of science. Along with this claim, the claim of his sacrifice to his country must for ever remain. When the war is over men of science should see to it that some national memorial to such lives be raised.

THE *National Geographic Magazine* for February publishes a well-illustrated article by an anonymous writer on "Our Foreign-born Citizens," in which the past and future of emigration into the United States are discussed. The literary test recently imposed will turn back one-fourth of the Armenians, two-fifths of the Serbians, Bulgarians, and Montenegrins, more than a fourth of the Jews and Greeks, more than half the South Italians, more than a third of the Poles and Russians, and a fourth of the Slovaks. More than 33,000,000 of people have already crossed the Atlantic, of which Great Britain and Ireland have contributed 8,500,000 and Germany more than 6,000,000. Ireland with more than 4,000,000, Great Britain with about 4,000,000, and Scandinavia with 2,000,000 have, together with Germany, contributed more than half the emigrants since the beginning of the Revolutionary War. It is estimated that the United States will have a population of nearly 500,000,000 in 2217, or approximately 166 to the square mile. But there is little danger of congestion, as statisticians estimate that the country has a sustaining power of 500 to the square mile, and assuming that one-third of the country is occupied by waste land, it will, on this basis, have room for a population of 900,000,000.

MR. EDWARD CLODD contributes to the *Fortnightly Review* for May an interesting article on Dr. Johnson and Lord Monboddo. An attractive picture is given of the active-minded judge, who, in his "Origin and Progress of Language" (1773–92), was one of the first to suggest man's relationship with the higher apes. There was considerable absurdity in Lord Monboddo's statement of his theory, but that it was a flash of genius is indubitable. Laughed at by his contemporaries, and ridiculed by the conservative Johnson, Monboddo was far ahead of his time. "Some of his speculations were anticipations of discoveries which have revolutionised thought and opinion in all directions; his was the creeping of the dawn when old things were passing away and all things were to become new." There is something fine in the conclusion of his long exposition of the resemblances between man and the apes: "That my facts and arguments are so convincing as to leave no doubt of the humanity of the orang-utan, I will not take upon me to say; but this much I will venture to affirm, that I have said enough to make the philosopher consider it as problematical, and a subject deserving to be inquired into. . . ." Mr. Clodd shows the naturalness of Johnson's attitude to Monboddo's subversive views. "But that attitude should convey the lesson to keep an open mind towards all matters, especially those that collide with our prejudices and contradict our 'certainties.'" As a wise Frenchman said, "Because science is sure of nothing, it is always advancing."

MR. J. HAROLD WILLIAMS contributes a study of heredity and juvenile delinquency to the *Eugenics Review* for April (vol. ix., No. 1). Twelve family histories are considered, and indicate the extreme importance of heredity in delinquency. At the same time, even in feeble-minded children delinquency is directly a product of environment. In nature and nurture, therefore, not separately, but collectively, must we look for an improved social being. The discussion on the disabled sailor and soldier and the future of our race, celebrating the Galton anniversary on February 16, is also included in this issue of the review.

The National Clean Milk Society has issued a report of an investigation into the hygienic quality of the milk supplied to babies attending certain schools for mothers. The milk was supplied by twenty-seven dealers, and a sample from each was examined. Only six of the samples contained not more than 500,000 bacteria per cubic centimetre; one contained more than 100,000,000. Two of the samples contained tubercle bacilli. Hints are also given how to inquire about the domestic milk supply, and details are given of the milk supply in certain American cities. The National Clean Milk Society (2 Soho Square, W.1) is doing good work and national service in trying to raise the standard of our milk supply. Its membership is open to all, and additional members are much needed.

A bee disease entitled "Sacbrood" is described by G. F. White in Bulletin 431 of the U.S. Department of Agriculture. This is not a new disease, but appears to have been included by bee-keepers under "pickled brood," a term which has acquired a very comprehensive meaning. "Sacbrood" attacks the larvæ in various stages, and is shown by the author to be transmitted in a "filterable virus"; no definite micro-organism can be detected.

A communication has reached us from Mr. Timmler, a civil servant in British conquered territory, German East Africa, New Langenburg, on the subject of the destruction of tsetse-flies. It is the somewhat surprising one of "gassing" the flies with a gas preferably innocuous to man, but fatal to the flies, or if deadly to man and flies, the use of masks, etc., would become imperative while operations were proceeding. The suggestion is that the monsoons would carry the gas across the fly-infested areas. We regard the proposal as impracticable, but an experiment would be better than any expression of adverse opinion.

An interesting lecture by Mr. Govindam, Deputy Director of Fisheries for Madras, is published in the "Book of the Madras Exhibition, 1915–16." Huge quantities of the Indian "oil sardine" have always been available on this coast, and formerly these fish were converted into a manure by simple drying on the beach. An intolerable nuisance, described as "the first line of coast defence," was the result, and the fertiliser produced was poor in quality. In 1909 the Fisheries Department introduced a simple method of expressing the oil and drying the resulting fish-cake to form a kind of guano of value as a fertiliser, since it contained little oil. The method was extensively copied by the natives, with the result that the value of the oil obtained rose from Rs.52,630 in 1910–11 to Rs.2,29,014 in 1913–14, while the corresponding values of the fish guano produced were Rs.13,648 and Rs.4,03,787.

Up to the present this year we have only received the first number of the *Kew Bulletin*, and it contains articles mainly of importance for the Colonies and India. There is a long systematic account of the fungus flora of the Uganda forests, which is the first attempt to give a comprehensive account of the fungi of this region, and is a useful step in the direction of the preparation of a fungus flora of tropical Africa. As regards India, several new species of plants are described by Mr. Gamble, which will be incorporated in his "Flora of Madras," now in course of publication.

The fungus diseases of Para rubber, *Hevea brasiliensis*, appear to be assuming rather large proportions, and are occupying the attention of mycologists in the East to a considerable extent. The species of Phytophthora which attacks the tapped areas of the stems forms the subject of a paper by Mr. J. F. Dastur in the Memoirs of the Department of Agriculture in India (vol. viii., No. 5, 1916). The fungus which is known as "black thread" causes black stripes on the tapping area, and is a serious disease in preventing the proper healing of the tapped surfaces. The black thread of Burma appears to be distinct from the disease of the same name recorded from Ceylon, which is due to *Phytophthora Faberi*, also the cause of a bad cocoa disease, and this fungus not only occurs as a canker on the stems, but also badly affects the seeds of Hevea. Remedial measures are discussed for the Burmese species, but the most efficacious measure appears to be to abstain from tapping the diseased trees during the rainy season. Accounts published of other fungus diseases of Para rubber in the Federated Malay States show that the future of the rubber industry may cause some anxiety.

The council of the Royal Agricultural Society has just issued the first of a proposed series of "Occasional Notes," by means of which it is hoped that the members may be kept more or less continuously in touch with the work carried on by the scientific officers of the society. The first number includes a note by Sir John McFadyean on joint-ill in foals; notes by Prof. Biffen on seeds, eradication of weeds in meadowland, and the spraying of potatoes for the prevention of "blight"; notes on insect pests by Mr. Cecil Warburton, and on certain points of interest in connection with fertilisers and feeding-stuffs by Dr. J. A. Voelcker. The matters dealt with are such as have previously been dealt with only in the annual reports of the officers, but through the medium of these periodical notes a more rapid and timely dissemination of information and advice will be secured, and the efficiency of the society's advisory work correspondingly increased. Reference may also be made to an excellent leaflet on the ox warble-fly, or bot-fly, which has been drawn up by Mr. Warburton and issued by the society.

An interesting report by Prof. V. H. Blackman and Mr. I. Jörgensen on the results obtained in 1916 in field investigations into the effect of overhead electric discharge upon crop production appears in the April number of the *Journal of the Board of Agriculture*. The experiments, which are a continuation of those initiated by Prof. J. H. Priestley, were carried out, as in previous years, at Lincluden Mains Farm, Dumfries, under the supervision of Miss E. C. Dudgeon. A uniform field of nine acres was used for the purpose, one acre being selected as the electrified area and two half-acre plots as controls. In comparison with previous years the charged wires were lower and closer together, so that the intensity of the discharge received by the crop was much increased. Oats were sown on March 27, and by May 16 the crop on the electrified area had established a marked lead, which it retained to the end. The discharge was applied for 848 hours during the season, being used only in the daytime and discontinued during actual rain. The final results showed for the electrified area the astonishing increases over the average of the control areas of 49 per cent. in grain and 88 per cent. in straw, the increased value of the crop being estimated at 6*l*. 7*s*. per acre. The cost of the current used, if taken at 1*d*. per unit, amounted to only 11*s*. The further interesting observation was made of a marked "after-effect" on the electrified area used in the previous year the clover crop which succeeded the oats

being much better on this area than on the rest of the field. It is pointed out in conclusion that many points still remain to be investigated before the use of the overhead electric discharge can be definitely recommended as a sound extension of agricultural practice.

THE growing importance of magnesite as a refractory material and for use in magnesian cement has led to its exploitation at the mining township of Bulong, in the N.E. Coolgardie Goldfield of Western Australia (F. R. Feldtmann, in Ann. Report Geol. Surv. of W. Australia for 1915). The material requires picking from the serpentine in which it occurs, but veins up to 2 ft. in thickness have been traced. In this, as in other instances, the magnesite is held to have been formed by waters containing carbon dioxide permeating a decomposing igneous complex of basic character.

WE have received from Mr. David Currie a letter relating to the article on "Empire Development and Organisation" which appeared in our issue of April 26. He directs attention to the fact that, although Canada is by far the largest producer of raw asbestos, Russia mines a substantial amount of this mineral, and Rhodesia is being developed as an important field. He regards the statement that the United Kingdom is largely dependent on outside sources, especially the United States, for its manufactured asbestos as incorrect, affirming that the imports from the States are "insignificant and even less than our exports to the States, in spite of the prohibitive tariff." The authority for the statement challenged by Mr. Currie is contained in paragraph 336 of the Blue Book Cd. 8462. Moreover, in the appendix (p. 172) the Commissioners state:—"It is to be noted that the United Kingdom, although possessing the most up-to-date plants and methods, is largely dependent on foreign sources for the manufactured asbestos it uses. In 1913 the net imports of asbestos manufactures were valued at 232,000*l.*, while the exports of asbestos manufactured in the United Kingdom (excluding engine packing) were valued at 105,000*l.* Quantities and countries of origin are not recorded."

THE *Revue générale des Sciences* for March 15 contains a clearly written and readable article on telemeters by Prof. H. Pariselle, of the French Naval School. It explains the principles on which telemeters act and describes the best-known instruments of each type. For infantry fire a simple and robust instrument is necessary, and no high degree of accuracy can be expected. A triangular slit in a small sheet of metal, held at arm's length and moved until a soldier seen at a distance fills the interval between the top and bottom edges of the slit, is a popular form of instrument, and is fairly accurate at small distances. For greater distances some form of double-image field glass or telescope has been much used. The two images of a soldier may be arranged to fall in the same vertical line, and the point on the upper image, at which the top of the head of the lower appears, may be noted, and the distance determined from its position. For the use of the artillery much more accurate instruments are necessary, and some form of double-image instrument, using a short base from the ends of which the two views of the object are taken, has come into universal use. The Barr and Stroud instruments use bases from 80 cm. to 274 cm., the shorter in field work and the longer in the Navy. Recently the Lawford-Copper instrument, on similar lines to the Barr and Stroud, but with a variable base, has been introduced.

WRITING in the *Scientific American* for April 21, Mr. Ellwood Kendrick deals with recent chemical developments in America. He points out that in treating metals the manufacturer has gone ahead by leaps and bounds, the reason being that, beginning with Andrew Carnegie and the Pittsburgh ironmasters, the chemist has been called in. He has also been welcomed in the petroleum industry, in the making of explosives, and latterly in the manufacture of coal-tar and other products. In other fields the chemist has not been wanted; the dread of the theorist has kept the doors of certain industries closed to him, with consequent waste and loss. After reference to the growing use of ferments and bacteria in chemical industry, Mr. Kendrick deals with a recent article on nitro-starch as an explosive. The difficulties with this nitro-product have been, in the first place, lack of stability when made by any practical method, and, secondly, difficulties in nitration owing to clotting, etc. It is claimed that the problem of producing a permanent nitro-starch has now been solved. By working up 80 to 85 per cent. with nitroglycerine a suitable explosive is obtained, and comparison is made between it and dynamite. Nitro-starch is claimed to be the cheapest of all high explosives. With present food problems, however, it can have no immediate interest for Europe. It is also stated that a licence has been granted in Switzerland for the manufacture of alcohol, primarily for industrial purposes, from calcium carbide. The works will be built at Visp.

THE annual general meeting of the Society of Chemical Industry is provisionally fixed to be held at the University of Birmingham on July 18–20. The following papers are promised:—"Chemical Porcelain," H. Watkins; "Duro-Glass," Dr. M. W. Travers; "British Sources of Sand for Glass and Metallurgical Work," Dr. P. G. H. Boswell; "Refractory Materials," W. C. Hancock; "Synthetic Nitrates," E. K. Scott; "Nitrates from the Air," Dr. Maxted; "Low-temperature Distillation Fuel," Prof. O'Shea; "Industrial Fuel from Gas Works," E. W. Smith; "Calorific Value of Industrial Gaseous Fuel," W. J. Pickering; "High-pressure Gas for Industrial Purposes," Mr. Walter; "Some Sources of Benzol and Toluol for High Explosives," T. F. E. Rhead; "Artificial Silk," L. P. Wilson; "Activated Sludge Process," E. Ardern; "Organisation of Industrial Research," H. W. Rowell; "Scheme for Co-operative Industrial Research," H. W. Rowell; "Vulcanisation of Rubber," Dr. D. F. Twiss.

OUR ASTRONOMICAL COLUMN.

COMET 1917*a* (MELLISH).—The following revised ephemeris for this comet, based upon a new orbit calculated from observations made on March 21, April 4, and April 20, has been received from Copenhagen:—

1917	R.A. h. m. s.	Decl. ° ′	Log Δ	Mag
May 27	1 56 28	−12 56·2	0·2236	7·2
June 4	2 7 28	14 11·5	0·2419	7·5
12	16 53	15 31·8	0·2559	7·8
20	24 45	16 59·8	0·2666	8·0
28	31 5	18 37·3	0·2748	8·2
July 6	35 46	20 25·6	0·2810	8·4
14	38 46	22 24·2	0·2859	8·6
22	2 39 54	−24 33·1	0·2901	8·7

The comet is now too far south for observation in Europe. It was apparently this comet which was observed in Australia on April 19, and described as a new comet (see NATURE, April 26, p. 172).

DISPLACEMENTS OF SOLAR LINES.—In continuation of previous work on iron, Dr. Royds has recently made an extensive series of comparisons of the spectra of the sun and arc for nickel and titanium, and has also investigated the displacements at the negative pole of the arc in the case of these elements (Kodaikanal Bulletin, No. 51). Unsymmetrical lines of nickel and titanium, as indicated by their behaviour at the negative pole, and by records of their appearance under pressure, were found to be very numerous, and it was only possible to confirm to a limited extent the conclusions arrived at from the lines of iron. It is considered, however, that the new results are not inconsistent with the conclusions deduced from iron by Mr. Evershed, namely, that the displacements at the centre of the sun's disc, and at the sun's limb, are Doppler effects due to descending motion in the line of sight, and that the solar pressure is of the order of three-quarters of an atmosphere. The spectrograph employed in these investigations has been provided with a new Anderson grating having 75,085 lines on a ruled surface of $9{\cdot}7 \times 12{\cdot}8$ cm.

THE PROBLEM OF SPIRAL NEBULÆ.—The view that spiral nebulæ may be distant galaxies, or "island-universes," is discussed in an interesting article by Dr. Crommelin in the May number of *Scientia*. In recent years this hypothesis has received considerable support from the discovery that a large proportion of the non-gaseous nebulæ are of spiral form, and by the accumulation of evidence that our own system has a somewhat similar structure. One of the chief difficulties with regard to it is the fact that such nebulæ are mainly concentrated in the vicinity of the galactic poles, thus suggesting a connection with our system, but Dr. Crommelin considers that this apparent avoidance of the galactic plane by the spirals may be explained by assuming the existence of patches of obscuring matter which become more numerous as the galactic plane is approached. Moreover, if the spirals were inside our system, their grouping would probably be about an axis through the centre of the galaxy, and not about an axis through our sun at right angles to the galactic plane. The alternative view that the spirals may be emanations driven out of our system by some agency seems to be rendered untenable by the recently discovered fact that their radial velocities are greatly in excess of any velocities which have been observed within the system. Dr. Crommelin concludes that most of the evidence seems to favour the extra-galactic position of the spirals, and if this view be adopted, it follows that they are of dimensions comparable with those of our galaxy. They are probably at a comparatively early stage of development, much of their matter being still scattered and diffused in clouds which reflect some of the starlight.

ELIAS ASHMOLE, F.R.S., FOUNDER OF THE FIRST PUBLIC MUSEUM OF NATURAL HISTORY.

MAY 23 next will be the three hundredth anniversary of the birth of Ashmole, antiquary, herald, and man of science. He included among his interests not only the entire world of Nature, but, like some physicists of the present day, he delighted to explore the regions of the preternatural. He has often been blamed, and we think unjustly, for devoting so much time to astrology and alchemy, which were the "scientific" pursuits in fashion at that period; but we should dwell upon what has lasted of his work rather than upon what was trivial and ephemeral. So far as science is concerned, the outcome of his lifework will always be memorable, for he became the founder of the first public museum of natural history in Great Britain; next, he must be regarded as the founder of the first university chemical laboratory; and, thirdly, he founded the first chair of chemistry in Oxford.

Ashmole was born at Lichfield, and received his early education at the local Grammar School. At the age of twenty-seven circumstances brought him, in the character of a commissioner of excise, to Oxford, where he continued his education in physics and mathematics as a member of Brasenose College, and imbibed from a Capt. George Wharton that taste for the study of astrology and alchemy which led him to give these subjects so much of his time. In October, 1646, he moved to London, and there for the next ten years eagerly assimilated the experimental facts and visionary lore of Lilly, Booker, and Martin Backhouse. He vigorously pushed forward his studies in astrology, chemistry, and botany; was a guest at "the mathematical feast at the White Hart"; edited Dr. Dee's writings; published the "Theatrum Chemicum," and, to quote Selden, "was affected to the furtherance of all good learning."

Ashmole lacked the touchstone of modern training which renders a student competent to discriminate between false and true learning; it was beyond the power of any one man to investigate every recipe for the philosopher's stone, and discover for himself the futility of this and similar quests. But during those years of research in London Ashmole arrived at the best method of stimulating interest in scientific matters, knowledge which was put to the best use some years later. We will not therefore regard him as a scientific observer nor as a successful experimentalist, but as the promoter of one of the most effective methods of primary scientific education, which aims at awakening and developing the intellectual activity of the young by putting before their eyes remarkable objects of natural history. Prof. Tyndall well expresses the essentials of the method in his address on "The Importance of the Study of Physics as a Branch of Education for all Classes"; he points out the great value of the incentive that the exhibition of natural objects and phenomena supplies in the stimulating of mental activity:—"As the nurse holds her glittering toy before the infant she would encourage to take its first step, so it would appear as if one of the ends of the Creator, in setting those shining things in heaven, was to woo the attention and excite the intellectual activity of His earth-born child." Without going so far as the distinguished physicist, in attributing motives to the Creator, we would insist that the more strongly the senses of the observer can be arrested by objects or phenomena of curious or unusual nature, the more vivid are the images of thought which are conjured up in the mind. When objects become commonplace, or operations a part of our everyday life, they lose this power of stimulation. Impressions arising from accidental circumstances often exercise so powerful an effect on the young as to determine the direction of a career. Humboldt relates that his early desire to visit tropical countries sprang partly from seeing some pictures of the shores of the Ganges in the house of Warren Hastings in London, and from the sight of a colossal dragon-tree in the old tower of a botanic garden. To a mind susceptible to impressions of this kind such object-lessons have the greatest educational value. And it is for this reason that Ashmole, as the founder of the first public museum of natural history, has the greatest claim to our consideration.

The oldest specimens in his museum had been collected by John Tradescant the elder (died 1638) during his travels in Holland, Russia, and Barbary, about the end of the sixteenth century. He left the collection to his son John (died 1662), who enriched it by adding new specimens collected on his travels in Virginia,

and, under the persuasion of Ashmole, published a catalogue of the whole collection. Although this catalogue appeared under Tradescant's name, allusions in the preface and the more definite statement of John Evelyn, "printed in his catalogue by Mr. Ashmole," make it almost certain that Ashmole was not only the instigator but also part compiler and editor of this, the first English, catalogue of a natural history museum. The keen interest Ashmole took in the collections would explain why Tradescant should have drawn up a deed of gift in 1659 making over the whole cabinet of rarities at his death to his friend, who, in 1674, after twelve years of controversy and litigation with the widow, moved the collections to his house in South Lambeth, where they were so carefully and methodically preserved as to elicit praise from Izaak Walton.

In 1677 Ashmole offered the whole collection, with the additions he had made to it, to the University of Oxford, on condition that a suitable building was provided for their display. His offer was accepted, a museum was built, the rarities were "put up in cases," and on March 14, 1683, the last loads "were sent to the barge" for transport to Oxford, and Ashmole "relapsed into the gout."

The preamble to his statutes, orders, and rules for the governance of his museum shows clearly that his intention was to provide the University with a museum of natural history, which should be primarily a scientific institution and not a "knick-knackatory," or a collection of historical relics and antiquities, such as has now come to be exclusively associated with his name at the New Ashmolean Museum, of which Sir Arthur Evans was the practical founder. The advancement of natural knowledge was Ashmole's first object; the accumulation of objects of art was not his purpose except in so far as those art objects served to illustrate the application of natural products. The preamble runs as follows:—

"Because the knowledge of Nature is very necessarie to humaine life, health, and the conveniences thereof, and because that knowledge cannot be soe well and usefully attain'd, except the history of Nature be knowne and considered; and to this is requisite the inspection of particulars, especially those as are extraordinary in their Fabrick, or usefull in Medicine, or applyed to Manufacture or Trade: I, Elias Ashmole, out of my affection to this sort of Learning, wherein myselfe have taken, and still doe take, the greatest delight; for wch cause also, I have amass'd together great variety of naturall Concretes and Bodies, and bestowed them on the University of Oxford, wherein my selfe have been a student, and of which I have the honor to be a Member. Lest there should be any misconstruction of my intendment, or deteriorating of my donation, I have thought good, according to the Acts of Convocation, bearing date Jun: 4: Ao 1683 and Sept: 19: Ano 1684, to appoint, constitute, and ordaine as follows." Then follow eighteen orders.

Order 6 is an example of his judicious foresight. It enacts "That whatsoever naturall Body that is very rare, whether Birds Insects, Fishes, or the like, apt to putrefie and decaye with tyme shall be painted in a faire Velom Folio Booke, either with water-colors, or at least design'd in black and white, by some good Master, with reference to the description of the Body itselfe, and the Mention of the Donor in the Catalogue; wch Booke shall be in the Custody of the Keeper of the Musaeum under Lock and key."

In these days of cheap photography the execution of this order would be a simple matter. Order 7 provides for the exchange or donation of duplicates, and by Order 8 old specimens are to be removed to cupboards.

The new building was constructed so as to include a lecture-room and a chemical laboratory, and for more than a century and a half it was the centre of scientific life in Oxford. For the further advancement of science Ashmole founded the first chair of chemistry in Oxford, and Robert Plot was appointed first Ashmolean professor, and also keeper to the museum. Unfortunately the founder's schemes for the adequate advancement of his favourite subjects were longer than his purse, and he did not live long enough to collect sufficient capital endowment to put the new professorship upon a permanent footing.

Ashmole is not likely to be forgotten in Oxford, yet the destiny that so often militates against just recognition in science has brought it about that his name, the museum and officers he created, are no longer used in accordance with his original ordinances. The museum in which he took so much pride no longer exists as such; even the knick-knacks to which his name is attached can no longer be seen in the building which he persuaded the University to provide; the old Ashmolean building, sadly in need of repair, is degraded to class-rooms, offices, and book stores; the greater part of the scientific specimens which he so greatly valued have been destroyed, and the few fragments that remain distributed; and Ashmole's keeper, relieved of the duties that were put upon him by the founder in respect of the natural history collections, is now in charge solely of the few curiosities which did not in Ashmole's opinion constitute the central feature of his museum.

A fitting commemoration of his name is to lay stress upon the fact that he was one of the pioneers of scientific education in England, that he earnestly endeavoured to promote learning, and that it is only by an error that his name has survived as a collector of curious antiquities. Of the old Tradescant and Ashmole collection some score or two of zoological specimens have survived from the seventeenth century. It is to be hoped that they may once more be brought together in accordance with their donors' wishes and their great historic value.

R. T. GUNTHER.

PUBLIC SCHOOLS AND NATURE STUDY.

THE unusual interest attaching to the report of the Rugby School Natural History Society for the year 1916 warrants our directing attention to the great service which our public schools may render to the cause of natural science. It is the jubilee number, and in addition to the usual features contains much other matter of exceptional interest. Special mention may be made of the racy and valuable paper by Canon Wilson, of Worcester, in which his personal reminiscences of the early history of the society, and, indeed, of the prehistoric period, are set forth with much humour and enthusiasm.

Though the fiftieth anniversary of the founding of the society was celebrated in March last, thus carrying us back to the year 1867—the tercentenary of the school—yet we learn that work on similar lines to those which the society follows to-day was carried on for some years previously. The geological museum dates from the time of Dr. Arnold. Canon Wilson went to Rugby as a master in 1859, and found a large collection of dusty and unnamed specimens in the Arnold Library. But one goes back yet another decade, and finds the year 1849 specially worthy of note. It was then that Dr. Sharp, a resident medical man, gave the first lectures on natural philosophy. Rugby School thus proclaims itself, not abreast, but in advance, of public opinion in regard to the position which natural science ought to occupy in liberal education.

In 1847 the British Association met in Oxford. Shortly afterwards a memorial was drafted for presenting to the University urging greater facilities for the study of natural history and science. It was, however, strangled in the birth, even so great an advocate of science as Buckland refusing to sign it. "Some years ago," he wrote, "I was sanguine, as you are now, as to the possibility of natural history making some progress in Oxford, but I have long come to the conclusion that it is utterly hopeless." We shall agree that it required some courage on the part of Dr. Tait to start the teaching of science at Rugby in the face of the almost universal condemnation of the study as frivolous and dangerous.

Between the years 1859 and 1864 Canon Wilson and others did some good voluntary work in geology. About this time a Royal Commission recommended that every boy should receive instruction in one or other of the sciences, and Dr. Temple engaged a science master from Birmingham with the view of carrying out the recommendation at Rugby. But Hutchinson could not enter on his duties till 1865, so Canon Wilson and Kitchener, who two years later became the first president of the Natural History Society, undertook to teach botany. Sir J. D. Hooker planned a course of study, and as the masters were not experts in the subject, they devoted their holiday to a six weeks' course at Barmouth, with Henslow as their coach. Such enthusiasm merited the reward it received.

The way was thus prepared for the inauguration of a society which should undertake the voluntary study of Nature, independently of the school curriculum, and on March 23, 1867, the Natural History Society was founded by a little group of eight boys and one master. The portrait of the master, Kitchener, is given as frontispiece to the current report. Some idea of the good work which the society has since accomplished may be obtained by reference to the pages dealing with natural history which give such value to the "County History of Warwickshire," in which the annual reports of the school are laid under frequent contribution.

Most young people probably have an inherent love of Nature, but it depends largely on early environment whether it will die or develop. More than one old Rugbeian has, in the course of the last half-century, made his mark in one department or other of natural history. Thus Longstaff, whose delightful book on "Butterfly Hunting in Many Lands" carries us round the world, writes: "As long as life lasts I shall be grateful to Mr. F. E. Kitchener and Canon Wilson for the substantial addition to my happiness that their instruction provided." Dr. Lucas, F.R.S., whose death last October was so greatly deplored, was another Rugby boy, and acted as curator and secretary in 1898, while the report for 1896 contains a paper by him on photomicrography. Worthington, whose interesting papers on "The Splash of a Drop" won for him election to the Royal Society, first developed his love for this subject while at Rugby.

And what shall we say of that famous Nimrod of modern times, Capt. Selous, whose "African Nature Notes" and other books reveal the perfect naturalist? His obituary, with an excellent photograph, finds a place in this report, but we owe to Canon Wilson a most romantic story of his successful attempt to obtain eggs from a heronry at Coombe Abbey, and the price he had to pay for his daring. We regret that we cannot find space to repeat the anecdote, with others of a similar kind.

That the work of the society is well maintained, and that the interest does not flag, is shown by the original papers as well as by the sectional reports. Without being invidious, we should like to direct special attention to the work of Greg and Bevington in ornithology. Such studies are of inestimable value to young people. They develop the powers of observation, teach patience, sympathy, endurance, and kindness, divert the mind from base pursuits, and open out a fairy realm of beauty and delight, which cannot fail to ennoble, as well as entertain, those who pursue them. Any public school not already in the possession of such an institution may be heartily recommended to follow the example of Rugby.

HILDERIC FRIEND.

AN INSTITUTE OF APPLIED OPTICS FOR FRANCE.

A SCHEME is on foot in Paris to establish an Institute of Applied Optics, with the object of securing closer co-operation between theory and practice in the optical trade. It has been suggested, according to an article in *La Nature,* that the scope of the institute should fall into three sections, viz. (i) a college of optics, providing a thorough theoretical and practical training for opticians, and promoting among its students a taste for optical research; (ii) a central optical laboratory, where tests of glasses and optical instruments would be made for men of science, public bodies, and manufacturers, and research work of general interest carried out; and (iii) a special trade school in which the students could obtain a thorough training in the practical branches of the trade.

It is proposed that the institute should publish transactions in a form following, say, the *Zeitschrift für Instrumentenkunde.*

The students of the college of optics would be recruited from the educated classes—Army and Navy officers, students or ex-students of the universities and technical colleges, astronomers, illuminating engineers, manufacturers of optical instruments, and doctors interested in physiological optics. There would be two distinct branches of instruction, viz. general optics and instrumental optics. The courses would be supplemented by lectures on all modern optical questions. The period of study is suggested as one year.

The central laboratory would serve as a test laboratory for manufacturers of optical instruments and for glass manufacturers, as a practice laboratory for the students, and as a research laboratory for the college staff.

The professional, or trade, school would take young people for three years and give them a thorough training in (i) glass-working, and (ii) construction and fitting up of optical instruments.

The scheme has received the favourable consideration of various Government departments and of certain scientific and learned societies in Paris; indeed, the publication of the transactions of the institute is already assured.

While it would be difficult to install the machinery and plant necessary for the trade section of the institute, it is suggested that the programme of the courses should be considered and the principal courses commenced in the school year 1917–18.

E. S. HODGSON.

THE MAN OF SCIENCE IN THE COMMUNITY OF TO-DAY.[1]

IT is not too much to say that for the first time in the history of the British Empire Science is coming into her own. It is no doubt humiliating to have to confess that it was the misapplied science of our enemies which demonstrated to us how inferior was the place we had given science in our own national

[1] From an address delivered to the Nova Scotian Institute of Science on November 13, 1916, by Prof. D. Fraser Harris.

life. The land that produced Roger Bacon, Napier, Gilbert, Harvey, Newton, James Watt, Jenner, Faraday, Darwin, Kelvin, and Lister had to be shown by the exponents of science prostituted that science was nevertheless worth cultivating for its own sake.

Possibly nothing less terrific than this irruption of Teutonic brutality would have shaken the British race out of its comfortable mental inertia. But having been awakened, let us thankfully admit that our rulers are now doing something towards recognising the all-pervading importance of science in the national life. Committees of various learned societies have been formed; the British Science Guild is taking action; the Royal College of Science has recently presented a petition to Lord Crewe to have men of science adequately recognised; and the Government from early in the war has been consulting men of science on a large number of economic problems. Quite recently Sir J. J. Thomson has been elected chairman of an important committee to study the position of science in secondary schools and at the universities and its relations to trades, industries, and professions which depend on applied science.

It cannot be denied that science, as science, has only very recently been allowed to have an independent existence in our national intellectual system. The time is within the memory of some of us when the attempt to introduce laboratory teaching into the University of Oxford was met with a furious resistance; and when at length studies in practical chemistry were instituted they were alluded to as "stinks." History was repeating itself; for Leo Africanus, writing in the early part of the sixteenth century, thus described the chemical society of the learned Arabians at Fez: "There is a most stupid set of men who contaminate themselves with sulphur and other horrible stinks."

Science is of the very warp and woof of the web of human existence; ought we not to reckon with it officially, as it is called? Has not the time come to *admit* that science is as important as it really has become; for the existence of something and the official admission that it exists are two different things? Why should not science be taken under the care of a Cabinet Minister? It is no longer vulgar, it is no longer beneath the attention of the aristocratic intellect; it is of preponderating usefulness to the nation, and it is malevolent only when divorced from common sense and common morality by the obsessions of self-hypnotised Prussians. It is within a very little of being even a profession! Why not recognise the pursuit of something which is almost a respectable profession? Why not have the official interests and the economic aspects of science presided over by someone who knows something about them?

We need to make science the keynote of our public service and university system, as Humboldt did early in the nineteenth century, when Prussia was as yet under the heel of Napoleon. The peremptory necessity of better scientific organisation is apparent; it is now a question not only of our prosperity, but also of our existence.

Science, in short, must have a Department, a Government office, before the public will fully accord it its place of honour. We may regret that this sort of thing has to be, but our regret will not change public opinion; and it appears to be part of the British Constitution that nothing can be done, or should be done, without a very large body of public opinion behind it. But the official recognition of science cannot wait until the public has seen fit to render science the homage it deserves. To begin at the top, let there be a Minister of Science and a Ministry of Science with just as much prestige accorded it as the War Office, the Foreign Office, or the Home Office. The duties of the Minister of Science would be primarily to foster science in every way possible, to further its interests, to administer its affairs somewhat in the manner in which the Board of Trade looks after trade, and the Board of Agriculture and Fisheries after agriculture and fisheries.

By friendly and intelligent co-operation with the universities, technical colleges, and the leaders amongst the manufacturers, the relations of science to the State could be adequately safeguarded; scientific men would be known, encouraged, subsidised, promoted, rewarded, and pensioned.

For why should State recognition, encouragement, promotion, and rewarding be reserved for sailors, soldiers, diplomatists, and lawyers? Why should it be so entirely correct to be paid for legal opinion, and such "bad form" to be remunerated for scientific advice? Because, you may rely, the law is an ancient, respectable profession, and science is so modern that it is not a profession at all. But this medieval state of affairs cannot go on indefinitely; it was all very well for the day when there was no science to foster, and men quarrelled so much that lawyers were kept very busy, but now "nous avons changé tout cela"—or at least the earlier part of it. One need not here and now draw up an exhaustive list of the duties of the Minister of Science, but may merely remark that much that falls under the supervision of the Home Office could be transferred to the Department of Science. Had there been such a department, Edward Jenner, for instance, would not have had to struggle against every kind of obstacle and misrepresentation for so long a time as he did, or have had to wait so long as he had for the official recognition of what he had done for suffering humanity. Not from his own private house, but from a Government department would the vaccine have gone forth to eager Europe. He truly called himself "The vaccine clerk of the whole world."

The first concern of the Science Office would be the place of science in the schools of the Empire. And here we come up against the still burning question of the rival claims of science and the classics. Of course, it ought to be perfectly possible to instruct boys in as much of Greek and Latin as would make them know the origin of the words in English derived from those languages, without necessarily making the boys read entire Greek and Latin authors in the original. The practice in the past of educating boys as though they were all going to be teachers of the classics is analogous to the teaching of physiology to medical students as though they were all going to be professional physiologists.

Owing to our national physiological momentum, the teaching of boys has been continued on the same lines as those laid down by the educationists of the Revival of Learning in the sixteenth century. What Erasmus, Linacre, and Dean Colet planned was admirable for the day when America and printing had only just been discovered, but is possibly not so well adapted to the country which lights its cities by electric energy, speaks to America without wires, flies in high heaven like the eagle, and descends to the abyss like a sea monster.

The Science Office will see to it that science receives official recognition in all entrance examinations whatsoever, and that it is not handicapped by receiving fewer marks than the classics or any other subject. Science must have its place in the curriculum, not on sufferance or by-your-leave, but by right and in virtue of its inherent dignity and usefulness. Science cannot any longer be the under-fed maid-of-all-work; Science is the queen herself coming into her kingdom.

Science is no longer to be merely permitted, tolerated, apologised for; she must preside at the council board because she already rules the lives of the people.

The academic precedence of the faculties, in which theology, arts, and law come before medicine and science, may still be tolerated at the old universities as an interesting and significant relic of earlier times; but in all modern universities (as in the University of Birmingham from its foundation) science is the premier faculty and takes the first place. The world advances, not because of Church history or Homer or Virgil, but because of James Watt and Stephenson and Dalton and Faraday and Harvey and Jenner and Darwin and Kelvin and Lister. Better fifty days of Faraday than a cycle of Aristotle.

Why is a knowledge of science so useful to the modern community? Apart altogether from the way in which science makes for technical efficiency, it is a means second to none in the training of the intellectual powers. It trains us in accuracy of observation, in the power of drawing trustworthy conclusions, in habits of precise thinking generally; and these are not small things.

Science, the true, is the patient, loving interpretation of the world we live in; it is a striving to attain not merely to an understanding of the laws whereby the world is governed, but to the enjoyment of the beauty and order which are everywhere revealed. And the minds of men capable of attaining to such heights of appreciation, and the evidences around us of an all-pervading personality, are only so many additional phenomena to be apprehended as constituent elements of that vast, sublime, age-enduring cosmos which we call the universe.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Liverpool.—The council has appointed Dr. P. G. H. Boswell as first holder of the George Herdman chair of geology Prof. Boswell graduated with first-class honours in geology in the University of London, and obtained the degree of D.Sc. in 1915. He has for some years past been lecturer in geology at the Imperial College of Science and Technology, London, and has published many original contributions to geological science. The establishment of a chair of geology in the University has been long delayed, and is now possible owing to the generosity of Prof. and Mrs. Herdman, who have endowed the chair as a memorial to their son, the late Lieut. George Herdman. Prof. Boswell will enter upon his duties in October next.

Prof. C. R. Richards, since 1911 professor of mechanical engineering in the University of Illinois, and head of the department, has been appointed dean of the College of Engineering and director of the Engineering Experiment Station of the University, to succeed Dr. W. F. M. Goss, who has resigned to become president of the Railway Car Manufacturers' Association of New York.

Under the will of the late Mrs. Denning, of South Norwood, property of considerable value has been left to form a "Frank Denning Memorial," with the object of promoting the application of modern scientific knowledge to the business life of the community. Mrs. Denning survived her husband only twelve months. The late Alderman Frank Denning was Mayor of Croydon at the time of his sudden decease, and was one of the leading directors of Welford's (Surrey) Dairies, Ltd. He was also a director of colliery companies in Gloucestershire. For some time before his death he was a governor of the Stanley Technical Trade Schools at South Norwood, and his interest had been aroused in the good work being done at these schools. It is not known at present how the terms of the trust will be carried out, but in view of the success of these schools, it is possible that some developments along the lines already laid down may be looked for. Mr. Denning was a business man before anything else, and the terms of the bequest seem to show that technical education is aimed at, and that pure science as a study had no large place in his mind.

The report of the Vice-Chancellor on the work of the University of London during the year 1916–17 shows that the total number of commissions granted from the outbreak of the war to December 31, 1916, to cadets and ex-cadets of the University contingent of the Officers Training Corps, and to other graduates and students of the University recommended for commissions, was not fewer than 3111; and the honours and distinctions conferred upon officers and cadets during the same period included one Companionship of the Bath, two awards of the Victoria Cross, six of the Distinguished Service Order, 157 of the Military Cross, one of the Distinguished Service Cross, and 199 mentions in despatches, besides from the French Government three awards of the Croix de Guerre and one of the Médaille Militaire. It is recorded that 284 former officers and cadets of the contingent, and thirty-three other officers recommended for commissions by the University, have made the supreme sacrifice for their country. About 21,000 members of the University are, or have been, serving with H.M. Forces. The research work normally conducted in the laboratories attached to the University has been to an increasing degree directed to the assistance of Government departments or other agencies concerned with the requirements of the war. In addition to the response made by teachers and qualified students at the medical schools of our hospitals to the demands of the War Office for physicians and surgeons, considerable services have been rendered to the Government in the departments of physics, chemistry, physiology, pharmacology, bacteriology, metallurgy, and civil, mechanical, and electrical engineering.

SOCIETIES AND ACADEMIES.

London.

Geological Society, May 2.—Dr. Alfred Harker, president, in the chair.—Jane **Longstaff** (*née* Donald): Supplementary notes on Aclisina, De Koninck, and Aclisoides, Donald, with descriptions of new species. Since the publication of a paper by the Geological Society on Aclisina in 1898, knowledge has been gained of the species there described, and six others new to science have been discovered. The diagnoses of these are given. The total number of species of Aclisina is brought up to twenty-two. The genus is best represented in Scotland, where the specimens are generally well preserved. A table is appended giving the range and localities in the British Isles and Belgium. A small variety of *Aclisina pulchra*, De Koninck, appears to have continued for the greatest length of time. Additional observations are also made on *Aclisoides striatula*, De Koninck.—T. H. **Burton**: The microscopic material of the Bunter pebble-beds of Nottinghamshire and its probable source of origin. As shown by the distribution of the heavy minerals, combined with (*a*) the direction of the dip in the cross-bedding, (*b*) the evidence adduced by boreholes and shaft-sinkings, a main current from the west is indicated. A large quantity of the material is derived from metamorphic areas. The source of the bulk of the material is probably Scotland, and the westward

adjoining vanished land, from rocks similar in the main to those of the metamorphic and Torridonian areas known in that country. The material was transmitted by means of a north-western river and its tributaries, flowing into the Northern Bunter basin. During certain flood-periods this river overflowed across Derbyshire, carrying its load of sediment, much of which was deposited in the pebble-beds of Nottinghamshire.

Linnean Society, May 3.—Sir David Prain, president, in the chair.—H. W. **Pugsley**: An enumeration of the species of Fumaria, section Sphærocapnos. The author alluded to Shakespeare's mention of "rank fumiter" in "King Lear." The earliest known references date back to Dioscorides in the first century, under the name of καπνὸς, smoke; the elder Pliny spoke of two species, one apparently our *Fumaria officinalis*. The modern generic name first appears in Bock (Tragus), Fuchs and Mattioli. Gerard, in his "Herball," includes the common fumitory as "*Fumaria purpurea*," but Gerard's description was altered and not improved by his later editor, Dr. Thomas Johnson. The enumeration in Ray's "Historia" was confined to the three species given by Gerard, but all the specimens in the Sloane Herbarium, and the Dubois herbarium at Oxford, prove to be a rampant form of *F. officinalis*. The true *F. capreolata*, an uncommon British plant, was added to our flora in 1859, when Prof. C. C. Babington read his paper on the genus before the Linnean Society. The *F. capreolata* of "English Botany" and Curtis's "Flora Londinensis" is Jordan's *F. Boraei*. With Vaillant's species, *F. Vaillantii*, there were six species distinguished before the time of Linnæus. In his "Species Plantarum" of 1753 the latter author has but two species of Fumaria; the remainder are now reckoned in Corydalis and other genera. The author then referred to works on the genus by Handschuch (1832) and Parlatore (1844), and especially the masterly monograph by Olof Hammar in 1857, the basis of recent work; a later monographer, Haussknecht, in "Flora," 1873, relied upon leaf-characters rather than the sounder characters afforded by the flower and fruit.—G. M. **Ryan**: The flowers of the Mahua, *Bassia latifolia*, Roxb. The tree and its products were described.—Dr. W. E. **Collinge**: (1) Paracubaris, a new genus and species of terrestrial Isopoda from British Guiana. (2) The oral appendages of certain species of marine Isopoda.—C. C. **Lacaita**: Two critical plants of the Greek flora.

EDINBURGH.

Royal Society, March 19.—Dr. John Horne, president, in the chair.—Dr. J. **Aitken**: Some nuclei of cloudy condensation. By means of an improved apparatus for producing a series of definite expansions of a given volume of saturated air, the author studied the cloud-producing qualities of dust particles of different sizes obtained in various ways. After the air was cleared of the largest particles by one or more applications of a 2 per cent. expansion, cloud-producing particles of smaller sizes were removed in succession by expansions 4 per cent., 6 per cent., 8 per cent., and so on up to 20 per cent. if necessary. The particles were produced by such means as flames, electric sparks, chemical action, and heating of solid substances; and the general conclusion was that in no expansion lower than 25 per cent. was there any evidence of electric ions being by themselves efficient nuclei for cloudy condensation. The view that the nuclei of cloudy condensation produced by heat are ions discharged at high temperatures is not supported, since such nuclei are produced at much lower temperatures than that at which ionic discharge from heated bodies occurs; and even at this higher temperature spectroscopic examination shows that some chemical or disintegrating action takes place along with the discharge of the ions.—W. L. **Calderwood**: Note on the salmon of the River Lochy as shown by a collection of scales made in 1916. The purpose of the paper was to compare the scales and weights of two groups of fish, distinguished as groups A and B. The members of group A had spent two years in the sea and one in the river, while the members of group B had spent two years in the river and two in the sea. The average weight of the former was the greater Thus the actual number of lines of growth as determined by the examination of the scales cannot be taken as a true index of the weight of the salmon. The condition in which the smolt leaves the river after only one year and commences a period of rich feeding in the sea may lead to a greater increment of weight than in the case of fish which are a year older but have spent the more normal period of two years' early life in the river.

PARIS.

Academy of Sciences, April 30.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: Fundamental hypotheses of the mechanics of pulverent masses.—General **Sebert**: Can violent cannonades produce rain? Comments on a recent note by M. Deslandres on this subject. There is some evidence that the rainfall produced may not be all local, but that effects may be observed at considerable distances from the front. Sudden changes of weather have occurred without previous barometric changes, heavy rainfall suddenly following on fine weather without any previous indication of the change.—C. **Richet**, H. **Cardot**, and P. Le **Rolland**: Regular and irregular antiseptics. Studies in lactic fermentation in presence of various antiseptics show that when large numbers of trials are made under conditions apparently identical, the resulting acidities are not constant, but deviate considerably from the mean. This deviation varies with the nature of the antiseptic present. Thus sodium fluoride is very regular in its action, and the average deviation is smaller than that given by the control tubes. Mercuric chloride, on the other hand, added in equal quantities to each tube, gave surprisingly variable results, the average deviation being ten times that of the controls.—Ch. **Depéret** and L. **Joleaud**: The marine Quaternary deposits of the region of Bône and of La Calle (Algeria).—C. **Guichard**: The O networks of Monge in space of any order.—M. de **Sparre**: Hammering in a conduit formed of three sections of different diameters, for which the duration of propagation is the same.—R. **Ledoux-Lebard** and A. **Dauvillier**: Contribution to the study of the L series of elements of high atomic weight.—M. **Ménard**: The treatment of hæmorrhoids by high-frequency currents. High-frequency currents (d'Arsonvalisation) are of high value in the treatment of hæmorrhoids, and in many cases have avoided a surgical operation which would otherwise have been necessary. The results of the application of the method in six cases are given in detail; the cure was complete and permanent.—M. **Marage**: The duration of cases of deafness due to shell-shock.

CALCUTTA.

Asiatic Society of Bengal, March 7.—Dr. G. A. **Boulenger**: A revision of the lizards of the genus Tachydromus. Tachydromus is a genus of Lacertidæ characteristic of the Far East, and the only one of the family that extends eastward of the Bay of Bengal. Owing to insufficient material, the relations of the various species have hitherto been very imperfectly understood, and the revision which Dr. Boulenger has now prepared was in consequence badly needed. Eleven species are recognised in the genus

and a key provided for their ready determination. Two forms hitherto placed in Tachydromus have been transferred to the new genera Platyplacopus and Apeltonotus.—Dr. J. **Stephenson**: Zoological results of a tour in the Far East: Aquatic Oligochæta from Japan and China. In this paper Dr. Stephenson gives an account of certain Oligochæte worms obtained by Dr. Annandale in Japan and China. The specimens were all found in fresh water and comprise five species, three species and one genus being described as new. *Criodrilus bathybates* was found in Lake Biwa at the remarkable depth of 180 ft.—Dr. N. **Annandale**: Zoological results of a tour in the Far East: Hydrozoa and Ctenophora. The Hydrozoa dealt with in this paper are mostly from the Tale Sap, in Lower Siam, where they were found living in brackish water. A single fresh-water form, *Cordylophora lacustris*, was obtained in the Tai Hu Lake in China. The paper includes an account of the habitat, adaptations, and distribution of all the Hydrozoa inhabiting brackish water connected with the Indian Ocean. *Asenathia piscatoris*, a new genus and species of Medusa from the Matla River, is also described, and it is suggested that the form may possibly represent the medusoid generation of a peculiar little hydroid recently described by Ritchie from Port Canning under the name *Annulella gemmata*.

BOOKS RECEIVED.

Steel and its Heat Treatment. By D. K. Bullens. Second impression. Pp. vii+441. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. 6*d*. net.

Seeding and Planting. By Prof. J. W. Toumey. Pp. xxxvi+455. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

The Elementary Principles of Wireless Telegraphy. By R. D. Bangay. Part ii. Second edition. Pp. 241. (London: The Wireless Press, Ltd.) 2*s*.

Some Compounds of Boron, Oxygen, and Hydrogen. By M. W. Travers, N. M. Gupta, and R. C. Ray. (London: H. K. Lewis and Co., Ltd.) 1*s*. net.

The Glastonbury Lake Village. By A. Bulleid and H. St. G. Gray, and others. Vol. ii. Pp. xxxiii–xl+353–724. (Glastonbury: Antiquarian Society.) Two vols., 3 guineas net.

Optical Theories. By Prof. D. N. Mallik. Pp. 181. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Cancer Problem: A Statistical Study. By C. E. Green. New edition. Pp. ix+140. (Edinburgh and London: W. Green and Son, Ltd.)

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1916. (London: H.M.S.O.)

Microscopical Determination of the Opaque Minerals. By Dr. J. Murdoch. Pp. vii+165. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s*. 6*d*. net.

Handbook for Rangers and Woodmen. By J. L. B. Taylor. Pp. ix+420. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Configuration of Astronomical Masses and the Figure of the Earth.—J. H. Jeans.
ROYAL INSTITUTION, at 3.—The Chromosome Theory of Heredity and the Alternatives: Prof. W. Bateson.
ROYAL SOCIETY OF ARTS, at 4.30.—The Future of Indian Trade with Russia: D. T. Chadwick.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual general meeting.

FRIDAY, MAY 18.

ROYAL INSTITUTION, at 5.30.—The Complexity of the Chemical Elements: Prof. F. Soddy.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Construction of Turbine-Pumps: A. E. L. Chorlton.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

MONDAY, MAY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Anniversary Meeting. President's Address.
ARISTOTELIAN SOCIETY, at 8.—Some Aspects of the Philosophy of Plotinus: Dean W. R. Inge.

TUESDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Architectural Design in Organisms: Prof. D'Arcy Thompson.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Tattooing in South-Eastern New Guinea: Capt. F. R. Barton.

THURSDAY, MAY 24.

ROYAL INSTITUTION, at 3.—The Chromosome Theory of Heredity and the Alternatives: Prof. W. Bateson.
ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Resources and Future of British Columbia: Dr. J. F. Unstead.
LINNEAN SOCIETY, at 3.—Anniversary Meeting.
AERONAUTICAL INSTITUTE, at 8.—The Testing of Materials for Aeronautical Construction: Edgar A. Allcut.
INSTITUTION OF MINING AND METALLURGY, at 5.30.—Shall Great Britain and America Adopt the Metric System?: W. R. Ingalls.

FRIDAY, MAY 25.

ROYAL INSTITUTION, at 5.30.—Breathlessness: J. Barcroft.
PHYSICAL SOCIETY, at 5.—An Investigation of Radium Luminous Compound: C. C. Paterson, J. W. T. Walsh, and W. F. Higgins.—The Resistance to the Motion of a Lamina, Cylinder, or Sphere in a Rarefied Gas: F. J. W. Whipple.—The Effect of Stretching on the Thermal and Electrical Conductivities of Wires: Dr. C. H. Lees.

SATURDAY, MAY 26.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

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THURSDAY, MAY 24, 1917.

ENGINEERING AERODYNAMICS.

The Flying-Machine from an Engineering Standpoint. By F. W. Lanchester. Pp. viii + 135. (London: Constable and Co., Ltd., 1916.) Price 4s. 6d. net.

THE greater part of this book is a reprint of the James Forrest lecture delivered by the author, and referred to already in NATURE of August 13, 1914. In the preface Mr. Lanchester lays so much stress on the new section called "The Theory of Sustentation" that no excuse is necessary for confining the remarks of this notice to the theory.

After reading the preface and the considerable claims made for the theory, a student of the subject will naturally look for a theory founded on the equations of motion, or at least on grounds not essentially experimental. It is, then, a surprise to find an almost complete absence of mathematical formulæ and reasoning, and any knowledge of orthodox hydrodynamics leads to questions as to the validity of many of the steps taken. After a time it is inevitable that the student will turn for relaxation to Kutta, whom Mr. Lanchester claims as a kindred spirit.

Kutta's mathematical problem is not difficult to follow, though doubts may be felt as to the physical meaning of his results. He takes as the subject of his analysis the two-dimensional flow of an inviscid fluid round a lamina in the form of a circular arc. Except for the case of a plane lamina moving in its own plane, it is well known that the Eulerian system of equations leads to a solution in which the velocity is infinite at two points, the leading and trailing edges of the lamina. To meet this difficulty Kutta introduces a circulation of the main mass of fluid, and chooses the amount of the circulation so as to avoid one of the infinite values for the velocity. There does not appear to be any limit to the angle of incidence or the curvature of the arc beyond which Kutta's method cannot be applied. To deal with the second point of infinite velocity Kutta found it necessary to change from a lamina to a body having a rounded leading edge, and this idea was put into better mathematical form by Joukowsky.

Kutta compares his calculated forces with those observed in wind channels, and claims good agreement after making an allowance for skin friction. This is essentially an empirical justification, and no attempt appears to have been made to show that the cyclic motion of an inviscid fluid has any mathematical connection with the real motion of a viscous fluid.

Having read Kutta, one returns to Mr. Lanchester. The difficulty of two points of infinite velocity is met by saying that if the section is properly shaped the flow is "conformable," *i.e.* includes the lamina in one of the stream lines, and further attention is confined to "conformable" wing shapes. In addition to a cyclic motion Mr. Lanchester introduces a pair of trailing vortices, which appear to extend Kutta's analysis from two dimensions to three dimensions. These vortices appear as though set up in the conventional inviscid fluid. The mechanism is not shown to us, and nowhere in the theory is there a clear distinction between the irrotational cyclic motion and the rotational flow in the vortices, nor even an estimate of the strength of the cyclic component. The theory ends with a formula for calculating the "sustentation" and "the aerodynamic resistance." To compare the results with those for a real fluid Mr. Lanchester estimates from experimental data a quantity which he calls "direct resistance," and which he adds directly to the "aerodynamic resistance." In the writer's view the theory, however excellent as an empirical formula, has no independent basis, and its utility is determined by the number of experimental observations which it will hold together.

Conventional hydrodynamics is interesting as a mathematical study, but work based on the properties of an inviscid fluid can scarcely be said to lead to results of value in explanation of the observed motion of real fluids. The equations of motion for a viscous fluid were given to us by Stokes, and are to be found in Lamb's treatise on hydrodynamics. For slow motion and very viscous fluids there is reason to believe that the motion is steady, and some solutions of the equations have been obtained, the most important being that of the flow in capillary tubes which leads to our best-known method for determining the value of the coefficient of viscosity.

Osborne Reynolds showed that the mathematical assumption of steady motion fails to account for observations when the fluid motion is rapid, and failure has led to approximations instead of to a fuller solution of the equations of motion of a viscous fluid. The physical conditions of the problem are usually modified by removing any trace of viscosity in order to make a simpler mathematical problem. Mr. Lanchester adopts this method in part, and is supported by all the standard treatises in the world. To a serious student of fluid motion such half-hearted theories produce difficulty and do not help to an understanding of the subject in its physical bearings.

Failure to satisfy the conditions observed may arise from defective equations or inability to solve correct equations. The evidence provided by Stanton and Pannell's experiments on surface friction in pipes appears to leave no doubt that the definition of viscosity derived from slow motions is sufficient for turbulent motion, and we must conclude that inability to deal with the mathematical analysis is the root trouble. An examination of the problem immediately brings into prominence a fundamental difference between inviscid and viscous fluids, the first of which may have a tangential velocity relative to a surface with which it is in contact, whilst the second has no relative velocity. It is not even

permissible to consider an inviscid fluid as the limit of one in which viscosity has been indefinitely reduced. No real fluid is known in which the viscosity is small enough to admit slipping at a solid boundary, or, for that matter, at any point in the fluid itself.

There is need for a solution of the well-known equations of motion for a viscous fluid, and great possibilities appear to exist for the student who has the courage to look the issue squarely in the face.

THE BRIQUETTING OF FUELS.

A Handbook of Briquetting. By Prof. G. Franke. Translated by Fred. C. A. H. Lantsberry. Vol. i., *The Briquetting of Coals, Brown Coals, and Other Fuels.* Pp. xxviii + 631. (London: Charles Griffin and Co., Ltd., 1916.) Price 30*s.* net.

THE work before us is a translation of the first part of Prof. Franke's well-known and important work on briquetting. The entire work deals with the whole subject of briquetting as applied to a very wide range of materials, but the first part, the translation of which has now been issued, is confined to the briquetting of coal. Although the full title is "The Briquetting of Coals, Brown Coals, and other Fuels," the author has practically confined himself to the two fuels that he has specified; nothing is said as to the briquetting of peat, although this part of the subject is far from unimportant, nor has the briquetting of other materials, such as sawdust, been dealt with. Within the limits in which he has chosen to confine himself the author has, however, done his work excellently well, and his book may fairly be regarded as a standard treatise on the subject.

The book is practically divided into two parts, the first dealing with the briquetting of bituminous coal, the second with the briquetting of lignite. The latter part is of less practical interest to us in this country, merely because we possess no deposits of lignite, with the exception of the quite unimportant ones at Bovey Tracey, in Devonshire, but is likely to be welcomed in British colonies where lignite exists. The first part, however, deals with a subject of most pressing importance, the urgency of which we have barely begun to realise. It is quite well known amongst coal-miners that millions of tons of small coal of the non-coking kind, unsuitable, therefore, for coke-making, are annually left behind in our collieries and lost for ever to the nation, because such coal is practically unsaleable, or at any rate commands but a very low price so long as round coal can be bought at a reasonable rate. Yet this small coal is every bit as valuable as lump coal as a source of heat, and could quite as readily be turned to good account. The thrifty Germans have, however, learnt to utilise what we waste, and hence it is that the manufacture of coal briquettes, or patent fuel, as it is usually called here, has made comparatively little progress in this country, whilst it has attained very important dimensions in Germany. Thus, according to Prof. Franke, the briquette production of Great Britain in 1906 was $1\frac{1}{2}$ millions of tons, whereas that of the German Empire (bituminous coal only) was $3\frac{1}{2}$ millions, whilst the respective production of bituminous coal was 255 millions and 137 millions of tons. One reason is that our adherence to old-fashioned, conservative methods stands in the way of the extended use of patent fuel in this country; we export fully 90 per cent. of the briquettes that we do produce, for which reason the manufacture of patent fuel is confined to our sea-board, and centres mainly in South Wales. On the other hand, some of the coals produced in our central coalfields, *e.g.* Nottingham and Derby, are exceedingly well suited to the production of briquettes, and the small coal of these districts ought to be thus utilised instead of being wasted.

Any colliery proprietor who is contemplating the manufacture of briquettes will find in the present work the fullest information as to every detail and every aspect of the subject, the author having performed his task in the most painstaking manner; perhaps the only fault that could be found is that he is somewhat too meticulous. Thus it scarcely seems necessary to describe, as he does in detail, the construction and mode of action of the ordinary Watts governor as applied to a simple horizontal engine that is used to drive a briquette press, but this fault is one on the right side. His successive chapters in the first part treating of bituminous coal are devoted to the raw materials, namely, coal and binders, crushing, mixing, drying, kneading and heating, pressing, loading and storage, design of complete plants, and economies and statistics; whilst the second part deals with lignite briquettes in an equally comprehensive fashion.

Whilst, therefore, we have nothing but praise for the manner in which the author has done his work, we must regret that the same cannot be said of the translator. This is, in fact, one of the poorest translations that we have ever seen. Two essential qualifications for producing an acceptable translation are a thorough knowledge of the language of the original and a good practical acquaintance with the subject-matter of the work. The translator, however, does not seem to understand German technical terms or to know their English equivalents. The result is a series of blunders, more or less grotesque, some of them veritable schoolboy "howlers." His ignorance of German is shown on the very first page, where he translates *Kohlensteine* by "coal-stones," and *Kohlenziegel* by "coal-bricks," whereas a moderate knowledge of the language would have told him that the proper words were "coal-bricks" and "coal-tiles" respectively. He translates *Setzmaschine, i.e.* "jig," by the utterly meaningless phrase "settling machine," and *Montanwachs,* literally "mine-wax" (a bitumen derived from lignite), he calls "Montana wax"! "Trans-

port band" may be an exact transliteration of the German original, but an English engineer would employ the usual phrase "conveyor-belt," in the same way that he would speak of the "flue" of a stove, and not, as the translator has done, of a "smoke-pipe." Unless the reader of this unsatisfactory translation himself knows German, he would be hard put to it to discover that what the translator calls the hard cast-iron "covers" of crushing rolls are really chilled iron roll-shells. No good purpose can be served by further extending this list of blunders; enough has been said to show that the reader must be on his guard throughout the book, and will have to use his ingenuity in order to arrive at the author's real meaning in many unintelligible passages.

Messrs. Griffin and Co. have earned for themselves a high reputation for their splendid series of technological publications, which have been productive of the utmost benefit to our industries, and it is a matter for grave regret that the present volume should fall so far below the high standard of excellence of these works. It is sincerely to be hoped that if a translation of the second volume of Prof. Franke's book is in hand, they will take care to have the proofs revised by someone capable of doing justice to the original.

H. L.

PROBLEMS OF BEHAVIOUR.

(1) *What is Instinct? Some Thoughts on Telepathy and Subconsciousness in Animals.* By C. Bingham Newland. Pp. xv+217. (London: John Murray, 1916.) Price 6s. net.

(2) *Studies in Animal Behavior.* By Dr. S. J. Holmes. Pp. 266. (Boston: Richard G. Badger, 1916.) Price 2.50 dollars.

THESE two books deal with the same subject—animal behaviour; but they could scarcely be more sharply contrasted, for the one is scientific and the other is not.

(1) Mr. Newland, as sportsman and field naturalist, has many interesting facts to submit and personal observations to relate, which is all to the good; but he has ventured on a line of interpretation where verification is impossible. His study of adaptive behaviour has led him to the conclusion that "the marvellous precision and fitness of these actions can only be attributed to Omniscience manifesting in the creature." In spite of the abundant illustrations of "trial and error" procedure to be found among animals, he tells us that "the creatures involved make no tentative experiments, but the perception of how and when to act comes to them subconsciously." But it is not exactly their own subconscious mind that operates; it is a "subconscious principle directly transmitted from the 'mainspring'—All-Mind." The life-principle (soul) of the insect or other member of the animal world is a centre of subconsciousness, temporarily set apart, but ever "in touch" with the All-Conscious. Hence their infallibility! Mr. Newland is altogether too metaphysical.

(2) We breathe a different atmosphere in Dr. Holmes's careful study, which adheres to scientific methods and verifiable formulæ. The book begins with an historical sketch which shows how the pendulum has swung many times between the extremes of generosity and parsimony, reading the man into the beast and reducing the animal to an automatic machine. The second chapter pictures the stages in the evolution of parental care, which is regarded as an extension of reproductive processes and as the foundation of social instincts. It is long, however, before it becomes necessary to insist on the psychical aspect of behaviour, which, objectively considered, cannot but be described as very efficient parental care.

The next three chapters deal with tropisms, which are prominent among lower organisms, and enter as components into the more complex activities of higher animals. While there are many orientations that may be described as tropisms and regarded as inevitable reflex effects, there are in other cases sundry complications which suggest more than the involuntary reaction of a "reflex machine." There is apparent selection of random movements, and there are modifications of routine which are consequent on experience. An account is given of the widespread phenomenon of the reversal of tropisms, and the variety of causes by which it is induced.

In regard to "learning" Dr. Holmes writes: "Given the power of forming associations between responses, the animal acquires new habits of action by repeating those responses which arouse instinctive acts of a congruous kind, and by discontinuing those responses which arouse instinctive acts of an incongruous kind." "The new things an animal learns to do are done because they have been assimilated to its instinctive activities." "The securing of any advantage through the method of trial and error presupposes congenital modes of response which are adapted to secure the welfare of the individual." Blundering into success would be of no service unless the organism were capable of turning to advantage its fortunate trial movement. "In order to do this the organism must be provided for the situation by its inherited endowment." "It is inheritance that affords the means by which inheritance is improved." We cannot do more than refer to the author's suggestive discussion of the way in which behaviour may help to mould form, of the analogy between behaviour and development, of the twofold origin of "feigning death," of the diverse modes of sex-recognition, and of the *rôle* of sex in the evolution of mind. The last chapter gives a charming account of a study of a bonnet monkey's mind.

The whole book is vividly interesting, and while the author flies a number of kites, he is careful to distinguish between fact and theory. He shows true scientific caution in stating his own views, and fair-mindedness in his criticism of those which he rejects. A distinctive feature of his method is the combination of analytic and genetic inquiry.

J. A. T.

OUR BOOKSHELF.

Studies in Insect Life, and Other Essays. By Dr. A. E. Shipley. Pp. ix+338. (London: T. Fisher Unwin, Ltd., 1917.) Price 10s. 6d. net.

IT is Dr. Shipley's gift to write scientific essays artistically, using many-coloured lights from reading and experience to illumine and humanise hard grey facts. He has humour and a light touch, and things are so interesting to himself that they become interesting to us. Not that we pretend to explain his style, which permits of luminous, dignified discourse on lice and fleas, as well as on fisheries and grouse. "Le style," said Buffon, "est comme le bonheur; il vient de la douceur de l'âme."

The book, based on previously published essays and lectures, has eleven chapters, dealing with insects and war, honey-bees, humble-bees, wasps, the depths of the sea, fisheries, Sir John Murray, grouse-disease, zoology in the time of Shakespeare, the revival of science in the seventeenth century, and hate. We have seen no more successful rapidly drawn picture of a haunt of life than is to be found in the chapter on "The Romance of the Depths of the Sea." Another fine picture of a very different kind is that of Sir John Murray. It is very interesting to have Dr. Shipley's lively summary of his own investigations on what is called "grouse-disease," of which, adapting Sydney Smith, he says: "Little stoppages, food pressing in the wrong place, a vext duodenum, and an agitated blind-gut, and there you have 'grouse-disease.'"

In the essay on hate an exposition is given, after Cannon and others, of the part the secretion of the supra-renal capsules plays in "the bodily changes which occur in states of extreme pain, fear, or rage, and serve to place 'un enragé' in an eminently favourable state for wreaking his passion on his opponent." It has been suggested that the use of golden mice in connection with emerods may have implied some awareness of the correlation between rodents (with their fleas) and bubonic plague; Dr. Shipley wonders whether the ancient Hebrews knew anything about the potency of the supra-renal capsules, because they were so very particular in their burnt offerings to offer up "the fat upon the kidneys." We have but one fault to find with this entertaining volume, that it comes to an end too soon.

The Tutorial Chemistry. Part ii., *Metals and Physical Chemistry.* By Dr. G. H. Bailey. Edited by Dr. W. Briggs. Third edition. Pp. viii+460. (London: W. B. Clive, University Tutorial Press, Ltd., 1917.) Price 4s. 6d.

THE general character of this widely known textbook was described in the review of the first edition which was published in NATURE for April 14, 1898 (vol. lvii., p. 559). In the present issue the second half of the section of the book dealing with physical chemistry has been completely recast by Mr. H. W. Bausor. The whole text has been revised, and the pages concerned with crystallography have been transferred to an appendix.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Stability of Lead Isotopes from Thorium.

SINCE my recent letter on the subject of "thorium" lead (NATURE, February 15, p. 469) I have had some correspondence with Dr. Arthur Holmes, who, in agreement with Boltwood, had previously concluded from geological evidence that lead could not be the end product of thorium, because thorium minerals often contain so little lead in comparison with what is to be expected from their age. He pointed out that the age of Ceylon thorite as determined from the ratio of lead to thorium was curiously anomalous. Taking, as preferable, Rutherford's values for the periods of uranium and thorium, 0·72 and 1·9 ($\times 10^{10}$ years) respectively (in the ratio of 1 to 2·6, instead of 3·2, the figure used in the previous letter), the proportion of the thorite lead derived from the thorium would be 95·5 per cent., and from the uranium 4·5 per cent. The quantity of thorium lead per gram of thorium would be 0·0062. The rate of growth would be $4·72 \times 10^{-11}$ gram of lead per gram of thorium per year, and the age of the mineral 131 million years. A Ceylon pitchblende (U=72·88 per cent., Pb=4·65 per cent.) has a ratio of lead to uranium of 0·064, giving the age as 512 million years, and Dr. Holmes considers that this is likely to be of the same geological age as the thorite, and to be, of all the Ceylon results, the most trustworthy for age measurements.

It must be remembered that there are two end products of thorium, both being isotopes of lead with the same atomic weight. Thorium-C, an isotope of bismuth, disintegrates dually, 35 per cent. of the atoms expelling first an α and then a β ray, and 65 per cent. first a β and then an α ray. More energy is evolved in the latter mode than in the former, and although the two isotopes have the same atomic mass and the same chemical character, there may be a difference in stability. From analogy with the uranium series, where the same thing is true for radium-C, except that all but a minute fraction of the atoms follow the second mode, it is the 65 per cent. isotope of thorium lead which should further disintegrate, for it is analogous to radium-D.

On the supposition that only the 35 per cent. isotope is stable enough to accumulate, the age of the mineral calculated from the data given would become 375 million years, in nearer agreement with the pitchblende. But the most interesting point is that if we take the atomic weight of the lead isotope derived from thorium as 206·0, and that from thorium as 208·0, and calculate the atomic weight of thorite lead on this basis, we get the same value, 207·74, which I obtained from the density, and Hönigschmid obtained for the atomic weight (207·77).

The question remains, What does the unstable isotope change into? Clearly the rate of change must be excessively slow to account for the apparently complete decay of the radiation of thorium-C. A β or an α ray expelled would result in the production of bismuth or mercury respectively, elements of which I could find no trace in the lead group separated from 20 kilos of mineral. But an α and a β change would produce thallium, which is present in the mineral in amounts that sufficed for chemical as well as spectroscopic identification. On this view, then, this particular lead should give a feeble specific α or β radiation, in addition, of course, to that produced by other lead isotopes present. Circumstances do not permit me to test the

point, but I understand Prof. Stefan Meyer may be making some examination of the radiations of the material, and the results he obtains will therefore be of very great value in deciding this point.

FREDERICK SODDY.

Aberdeen, May 14.

PROF. SODDY having given me the privilege of reading his letter in advance, I should like to take the opportunity of directing attention to the geological age of the thorium minerals of Ceylon, and to a few further statistics bearing on the suggestion that only 35 per cent. of thorium produces a stable isotope of lead. I am indebted to my friend, Mr. E. J. Wayland, late assistant mineral surveyor of Ceylon, for the following provisional classification (in order of age) of the older rocks of the island:—

(6) Newer pegmatites and quartz reefs.
(5) Welipatanwila series of sediments.
(4) Pyroxenites.
(3) Hornblende, zircon, and other pegmatites of the Balangoda series (source of thorite and thorianite). Galle group, and crystalline limestones (?)
(2) Charnockite series (pyroxene granulites).
(1) Older rocks of the basal complex, including gneisses, with monazite and zircon, pegmatitic secretions, and dioritic intrusions.

This classification clears up much of the mystery in which the thorium minerals of Ceylon have hitherto been shrouded. It was thought at first that they belonged to two distinct periods (Nos. (1) and (3) in the above list), and as the figures in the table given below clearly indicate, the belief was curiously supported by the Pb/U ratios. However, it is now fairly established that thorite and thorianite do not occur in the older rocks of the basal complex, and therefore the higher lead-ratios are misleading for age measurement. The only lead-ratios of any value for this purpose are those of *uraninite* and *zircon*, the former being of the same age as the thorium minerals, while the latter belongs to the pre-Charnockite zirconiferous rocks, and is therefore very much older.

In the following table I have recalculated the lead-ratios on the assumption that 35 per cent. of thorium gives lead as a stable end product; or, in other words, that, weight for weight, thorium produces in any given time only one-seventh as much lead as uranium.

Mineral	Pb per cent.	U per cent.	Th per cent.	Pb/U	Pb/(U+0·14 Th)
Thorianite	2·66	10·4	67·1	0·26	0·133
,,	2·30	11·1	60·3	0·21	0·117
,,	2·10	9·5	63·7	0·22	0·110
,,	2·36	11 4	69·5	0·21	0·110
,,	2·42	12·8	69·4	0·19	0·102
,,	2·76	21·0	44·1	0·23	0·100
Thorite	1·28	4·6	62·8	0·28	0·094
Thorianite	2·78	23·0	55·0	0·121	0·090
,,	2·70	23·8	55·9	0·114	0·085
,,	1·87	13·1	67·3	0·14	0·082
,,	2·16	24·8	54·9	0·087	0·066
,,	2·38	27·8	51·7	0·086	0·066
Thorite	0·78	3·5	59·2	0·22	0·065
,,	0·36	1·62	54·4	0·22	0·045
Average	—	—	—	0·18	0·09
Uraninite	4·65	72·88	7·7	0·064	0·063
Zircon	0·092	0·56	0·01	0·164	0·164

(For references see Proc. Geol. Assoc., vol. xxvi., p. 301, 1915.)

The recalculated ratios approach that of uraninite much more closely than do the simple Pb/U ratios, and thus they support Prof. Soddy's suggestion better than might have been expected from analyses of thorium minerals.

I have elsewhere pointed out the unsuitability of thorium minerals for age determination or correlation, and this is particularly so in the case of minerals from the Palæozoic igneous rocks of Langesundfjord, Norway. Mr. Lawson and myself based our former conclusion that lead could not be the end product of thorium largely on analyses of these minerals. However, I have now recalculated the ratios on the assumption that thorium has one-seventh the lead-producing power of uranium, and it is satisfactory to find that, when thorium is less than five times as abundant as uranium, the ratios agree as closely on this calculation as do the simple lead-ratios. When thorium is more than five times as abundant as uranium neither set of ratios gives any approach to agreement, although the minerals from any one locality agree among themselves. (For the analyses referred to, see *Phil. Mag.*, vol. xxviii., p. 832, 1914; and Proc. Geol. Assoc., vol. xxvi., p. 302, 1915). Thus, having found from experience that the pernicious and irregular behaviour of thorium minerals is apt to be very misleading, I must admit that their evidence is worthless in the absence of atomic weight determinations.

An atomic weight determination by Richards and Lembert on lead from Ceylon thorianite may be used (in the same way as Prof. Soddy has used his own and Hönigschmid's measurements) to test the question of end product. The thorianite referred to contained 60 per cent. Th and 20 per cent. U, and therefore if the whole of the thorium disintegrated into lead, the atomic weight should be 207·32; whereas if only 35 per cent. of the thorium formed lead, then the atomic weight should be 206·73. Remembering that the presence of original lead is implied by the high lead-ratios of the above table, and that such exogenous lead would raise slightly the latter figure, one finds with pleasure that the atomic weight actually found was 206·82. Prof. Soddy's suggestion thus affords a happy compromise as to the end products of thorium; there is already accumulative evidence in its favour, and as yet there is none against it. In particular it is satisfactory to observe that if the suggestion should receive decisive demonstration, then the estimates of geological time already based on lead-ratios are not appreciably affected.

ARTHUR HOLMES.

Imperial College of Science and Technology, S.W.7, May 16.

THE SUSPENDED PUBLICATION OF THE "KEW BULLETIN."

WE learn with astonishment that it appears to have been decided to suspend the publication of the *Kew Bulletin*. We say "appears," because it seems almost incredible to anyone with a sense of proportion of the issues involved that such an unfortunate step can really be seriously contemplated. It is, however, announced that the Controller of H.M. Stationery Office (the publisher) has been instructed to form a priority list of printed books and to defer the publication of everything which is not essential, that it has been ruled that the *Kew Bulletin* is not essential, and that its publication has therefore been suspended. It would be of interest to know what steps were taken to enable a considered judgment to be arrived at as regards this useful publication, and to what extent those responsible for its discontinuance are competent to form a just opinion on the merits of what is mainly a technical journal.

The objects served by the *Kew Bulletin* since

its inception in 1887, partly as the result of a suggestion made in the House of Commons, are manifold and far-reaching. Not only does it serve as the official organ in which the results of scientific activity at Kew are largely given to the world; it also serves the very important function of placing at the disposal of the economic and scientific gardens in India and the Colonies the latest facts in economic botany that may be of importance to them.

It must be remembered that Kew is the central institution of a great system of smaller institutes established in every region of the Empire, and that these institutes exist to further the material prosperity of the countries in which they are situated. The principal sources of wealth in most of our foreign possessions consist for the most part of vegetable products, and it is difficult to overrate the importance of keeping the botanical stations, remote as they mostly are from the main channels of current scientific work, continually informed on relevant matters which from time to time reach the great clearing-house at Kew. It must be evident to everyone that any action which tends to lower the efficiency of these institutes of economic botany must operate in a manner detrimental to the material interests of the country or countries thus affected. It is difficult to believe that either the India Office or the Colonial Office, which are both concerned with the functions that only Kew is in a position effectively to discharge, can have been consulted in the matter, or, if they had been so consulted, that they could have approved of a step so unsound alike on economic and financial grounds.

Furthermore, it should not be forgotten that Kew receives a good deal from other countries by way of exchange for the *Bulletin*, which it is now proposed to suspend. We understand that enemy countries, although their colonial interests are as nothing compared with our own, have, nevertheless, not seen fit to interfere with the continued publication of their own corresponding journals.

In fact, the same official lack of appreciation of the importance of scientific inquiry and research which was a matter of common knowledge amongst our competitors before the war still continues to sap the foundations of our recognised claims to our foreign possessions, which should largely rest on the encouragement of their material development on sound economic, and therefore on scientific, lines.

It is earnestly to be hoped that the action apparently taken may be reconsidered before we allow ourselves, as a colonial Power, to be made ridiculous, and as a business people to stand committed to the policy of penny wise and pound foolish.

Unless we learn in time the lessons which this war is enforcing on every side, namely, that the way of prosperity in the future lies in promoting scientific knowledge and in utilising the results of scientific investigation, it will make but little difference in the long run whether we win the war or not. For we should assuredly lose in the far more serious conflict that is certain to follow it, a conflict in which the claim for superiority will be inexorably decided against any nation which refuses to take full advantage of that knowledge which is power in a sense far more real than ever before.

J. B. F.

CONSERVATION OF WILD LIFE IN CANADA.

IN spite of the energy with which the Canadians are devoting themselves to the prosecution of the war and its successful conclusion, the necessity of conserving our natural resources is not being forgotten. Not the least important of these resources is the wild life of the Dominion. The economic value of the wild life to the country is fully realised by the Canadian Government. On this account it is taking steps to conserve, while it is still able to do so, the wild life upon which many of its economic interests depend. The necessity of greater protection for the species of migratory birds which are important to agriculture as insect destroyers was mainly responsible for the conclusion of the recent international treaty with the United States for the protection of migratory birds in Canada and the United States. This treaty is undoubtedly the most important and far-reaching measure ever taken in the history of bird protection. The full text of the treaty and the circumstances responsible for its consummation are given in an article by the present writer in the *Agricultural Gazette of Canada* for December last. In addition to the protection of insectivorous birds, the treaty provides that no species of migratory wild-fowl, such as ducks, geese, or shore-birds (plovers, sandpipers, etc.), shall have a longer open season than three and a half months, and the open seasons are so restricted as to prevent the killing of the birds in the breeding season. Close seasons for periods of several years are provided for certain species of birds the continued existence of which has become seriously menaced.

In the north-west territories the fur-bearing animals and such larger animals as the barren-ground caribou and musk-ox constitute the only available natural resources, and the existence of the present and future populations of large portions of that unorganised territory largely depends on the presence of such wild life. Steps are therefore being taken to ensure the conservation of the northern wild life by improved legislation. In order that this problem may be carefully studied with a view to the adoption of an adequate policy for the protection and use of the wild-life resources of the country, the Canadian Government has recently appointed an inter-departmental Advisory Board on Wild Life Protection, consisting of the following:—Mr. James White, Assistant to the Chairman of the Commission of Conservation (chairman); Mr. D. C. Scott, Deputy-Superintendent of Indian Affairs; Mr. J. B. Harkin, Commissioner of Dominion Parks; Dr. R. M. Anderson, in charge of mammals in the National

Museum; and the present writer, who is secretary of the Board.

The Dominion and Provincial Governments have been active in the establishment of animal parks for the protection of game and non-game mammals and birds, and many thousands of square miles of territory have now been reserved as animal refuges, where hunting is absolutely prohibited.

The successful effort of the Canadian Government in preventing the extermination of the American bison, or buffalo, is noteworthy. The original herd of 750 buffalo that the Government purchased in the United States in 1907 and placed in a special enclosed buffalo park of 168 square miles at Wainwright, Alberta, has now increased to more than 2400, and altogether above 3000 buffalo are now under Government protection, including the wild herd of about 500 head in the Peace River region south-west of Great Slave Lake. With the view of ascertaining the possibilities of the buffalo in relation to agriculture, the Canadian Department of Agriculture is now carrying on experiments in crossing the buffalo with domestic cattle, as the cross-bred animals, like the buffalo, are so admirably suited to withstand the most rigorous conditions of a northern environment and produce excellent beef and superior robes.

A report published by the Commission of Conservation on the fishes, birds, and game of Canada last year gives an excellent account of the manner in which these problems are being dealt with in Canada. Constituting as Canada does the last stronghold of the big-game animals of the North American continent, it is hoped and believed that we shall be successful in preventing the reduction to the point of extermination of the many forms of wild life of interest and importance alike to the settler, the sportsman, and the zoologist.

C. Gordon Hewitt.

PROF. JOSEPH RIBAN.

Prof. Joseph Riban, honorary professor of the Faculty of Sciences of Paris, who has just died at the ripe age of eighty, was one of a type of French chemists which is fast disappearing. Born at Montpellier, he was originally destined for a career in medicine, but under the influence of Balard, the discoverer of bromine, he was led to interest himself in problems connected with pharmacological chemistry, and took up the study of the toxic principle of redoul (*Coriaria myrtifolia*), which he found to be a glucoside and named coriamyrtine. His work on the physiological, chemical, and physical properties of the new substance occupied him during the greater part of 1864, and the results appeared in a couple of memoirs which were published in the *Journal de Pharmacie* and in the Bulletins of the Chemical Society of Paris. Although he continued to follow medicine, Riban was more and more attracted to chemistry, and his nomination as professor of chemistry and technology at the Ecole Normale of Cluny eventually settled his career. In 1869 he joined his old master Balard at Paris as *préparateur* of his course at the Collège de France.

The Franco-German War interrupted his chemical studies, and during the siege of Paris he was a zealous collaborator of Alphonse Guérin at the military hospital in the Rue des Récollets. On the termination of hostilities he was able to resume his chemical work, and a number of papers appeared in rapid succession, on the products of the condensation of valeric aldehyde, and on aldehydes condensed by the elimination of water, known as *aldanes*, on the terpenes and their chlorohydrates, on terebene, and on camphene. Riban's investigations in what is confessedly one of the most intricate and difficult fields of organic chemistry attracted considerable attention at the time of their publication. They gained for him his degree of doctor of physical sciences, and eventually, in 1875, the Jecker prize. The first samples of synthetic camphor arising out of these researches were shown in the Exhibition of 1878.

Riban now became associated with Berthelot at the Collège de France, and was transferred to the Sorbonne, where he became assistant-professor of quantitative chemical analysis. He practically abandoned inquiry in organic chemistry, devoting himself more particularly to general problems of applied chemistry, especially to questions of hygiene. In addition to his work as director of the analytical laboratories at the Sorbonne, he lectured at the Ecole des Beaux-Arts, and was named a member of the Conseil d'Hygiène. These various public duties left Riban little time for original research, but he published a number of notes and minor communications on compounds of phosphine and on the decomposition of metallic formates and acetates in presence of water, as well as some papers relating to eudiometry and analytical chemistry. He was an active contributor to the "Encyclopédie Chimique" and to the "Dictionnaire de Chimie," and in 1899 published a treatise on electrochemical analysis which enjoyed a considerable reputation.

Riban became a vice-president of the French Chemical Society in 1898, and a vice-president of the Conseil d'Hygiène in 1899. He was a careful, conscientious teacher, distinguished for the clarity and simplicity of his exposition, and a painstaking and accurate experimentalist whose work rests upon a solid and durable foundation.

NOTES.

The valuable article on rhubarb which appears elsewhere in the present issue was prepared for the *Kew Bulletin*, the publication of which has been suspended on the ground of shortage of paper. When we see the waste of paper used in Parliamentary Reports, National Service propaganda, and by Government departments generally, and place this by the side of the amount required for the continued publication of such a periodical as the *Kew Bulletin*—Imperial in its scope and influence—we begin to despair that our State

officials will ever possess true standards of value in matters pertaining to science. The subject is dealt with in an article on another page; and all we wish to say here is that we are glad to accord the hospitality of our columns to a contribution intended for the *Kew Bulletin*, and that we earnestly hope action will be taken to secure the continuance of a publication which is more essential now than ever it was. So many misleading statements have recently been made about rhubarb that such an accurate account of the plant as is given in the present article, if made widely known to the public, should save much suffering and needless loss of life.

We notice with much regret the announcement of the death on May 18, at seventy-eight years of age, of Sir Alexander R. Binnie, past president of the Institution of Civil Engineers, and from 1890 to 1902 chief engineer to the London County Council.

The late Lord Justice Stirling's herbarium, consisting chiefly of about 6000 varieties of mosses and liverworts from many parts of the world, has been presented by Lady Stirling to the Tunbridge Wells Natural History Society.

The Canadian Government has recently appointed Dr. C. Gordon Hewitt to be consulting zoologist, in addition to his duties as Dominion entomologist and chief of the entomological branch of the Department of Agriculture. The duties of the office will be to advise in matters relating to the protection of birds and mammals and the treatment of noxious species.

The death is announced, in his eighty-fifth year, of Dr. Ephraim Cutter, a distinguished American microscopist and inventor of many surgical and gynæcological instruments. He was a pioneer in American laryngology, and had studied the morphology of raw beef since 1854. In 1894 he discovered the tuberculosis cattle test. He was an expert in food values, and was the author of more than 800 contributions to the literature of medical science.

An association having the title, Society of Industrial Chemistry, has recently been formed in France. The honorary president of the new society is Prof. Haller, of the Institute, and its object is the development of the chemical industry in France in order that it may be given that prominence which will be necessary in the after-war struggle. The society comprises manufacturers, engineers, and chemists. The headquarters of the society are at 49 rue des Mathurins, Paris.

The Franklin medal of the Franklin Institute, Philadelphia, has been awarded to Dr. H. A. Lorentz, For Mem.R.S., president, Royal Academy of Sciences, Amsterdam, and professor of mathematical physics, University of Leyden. The Franklin medal has also been awarded to Admiral D. W. Taylor, Chief Constructor, Chief of Bureau of Construction and Repair, United States Navy. The medals were presented on May 16, when an address was given on "The Science of Naval Architecture" by Admiral Taylor.

At the annual meeting of the Royal Geographical Society on Monday the medal awarded to Mr. G. G. Chisholm by the American Geographical Society was presented to him by Mr. Page, the United States Ambassador. The Royal medals and other awards announced in Nature of March 22 were presented by the president, Mr. Douglas W. Freshfield. The president referred to work being done by geographers in different parts of the war area, and he remarked:—"In a hero of the recent sea-fight against odds off Dover—a fight that recalls the glorious traditions of the days of Queen Elizabeth—we are proud to recognise an Antarctic explorer, the second in command of Capt. Scott's last expedition, Capt. Evans. It is the same energy and spirit that lead men to face the Antarctic blizzard or the foe that walks in darkness off our own coasts." Sir Thomas H. Holdich has been elected president of the society in succession to Mr. Freshfield.

We learn with deep regret that 2nd Lieut. H. E. O. M. Dixon, Seaforth Highlanders, has died of wounds in France. The son of the Rev. J. Murray Dixon, of Smithland Rectory, Loughborough, he was born in 1885. His ambition, which showed itself when he was quite young, was to excel as an artist, and birds formed the favourite theme for his pencil. Though he modelled his work largely on that of Archibald Thorburn, for whom he entertained an immense admiration, he showed promise of developing a style of his own. He was especially keen on game-birds, but wildfowl of all kinds fascinated him, and he was never so happy as when tramping the hills of Scotland after grouse and deer. His many friends will read with pride the comments of his Colonel: "He was a brave and cool leader of men." He fell on April 9, when rallying his men for the attack on the German second line of trenches, shot down by machine-gun fire, to die of his wounds on the following day. By his death ornithology has lost a devoted disciple, but his work and his memory will ever be cherished among us.

The appointment is announced of a Civil Aerial Transport Committee, to inquire into civil aerial communications after the war; the committee is constituted as follows:—Lord Northcliffe (chairman), Major Baird (deputy-chairman), the Duke of Atholl, Lord Montagu, Lord Sydenham, Mr. Balfour Browne, Mr. A. E. Berriman, Mr. G. B. Cockburn, Mr. G. Holt-Thomas, Mr. Claude Johnson, Mr. Joynson-Hicks, Mr. F. W. Lanchester, Lieut.-Col. M. O'Gorman, Major-Gen. Ruck, Mr. J. S. Siddeley, Mr. T. Sopwith, Mr. H. G. Wells, Mr. H. White-Smith, Mr. W. Tyson Wilson, Sir Laurence Guillemard, Col. J. W. Pringle, the Earl of Drogheda, Mr. G. E. A. Grindle, Mr. G. E. P. Murray, Sir Thomas Mackenzie, the Rt. Hon. W. P. Schreiner, and Capt. Vyvyan. Brig.-Gen. Brancker will represent the R.F.C. The Meteorological Office has also been asked to name a representative, and one or two additional names will be announced later. Mr. D. O. Malcolm will be the secretary of the committee, and the offices will be at Winchester House, St. James's Square.

As already announced, the annual congress of the South-Eastern Union of Scientific Societies is to be held this year in London, in the lecture hall and rooms of the Linnean Society, on June 6–9. Dr. William Martin, formerly general secretary of the union, is the president for the year, and will take for the subject of his address on June 6 "The Application of Scientific Method." Among the many interesting items in the programme of the congress, the following papers and addresses may be mentioned. On June 7 Dr. A. Smith Woodward, "Vertebrate Remains from London Excavations," and Mr. E. A. Martin, "Some Skulls and Jaws of Ancient Man, and his Implements." On June 7, too, members of the congress are invited to the Hooker lecture of the Linnean Society by Prof. F. O. Bower. On June 8 Prof. E. W. MacBride, "Are Acquired Characters Inherited?"; Dr. G. A. Boulenger, "Reptiles in Captivity"; and Dr. B. Daydon Jackson, "Notable Trees and Old Gardens of London." On June 9 Dr. J. S. Haldane,

"Abnormal Atmospheres and Means of Combating Them," and Prof. G. S. Boulger, at the Chelsea Physic Garden, "The Associations of the Garden with the History of Botany." During the meeting there will be several visits to places of scientific interest. All subscriptions must be sent direct to the hon. general secretary, Mr. H. Norman Gray, 334 Commercial Road, London, E.1.

WE regret to record the death of Mr. Benjamin Hall Blyth on May 13, in his sixty-eighth year. An account of his career appears in *Engineering* for May 18, from which we take the following particulars. Mr. Blyth served his pupilage to civil engineering with Messrs. B. and E. Blyth in Edinburgh, and in 1871 became a member of the firm of Messrs. Blyth and Cunningham. The work undertaken by this firm grew very rapidly—between 1871 and 1877 Parliamentary plans for work estimated to cost 6,000,000*l.* passed through its hands. Mr. Blyth joined the Institution of Civil Engineers in 1877, became a member of the council in 1900, and was elected president in 1914. He was consulting engineer to the Caledonian, the North British, and the Great North of Scotland Railways. He was responsible for the two great stations, the Central in Glasgow and the Waverley in Edinburgh. Mr. Blyth was also engaged in dock enlargement and improvement at Grangemouth and at Methil; both these docks are fully equipped with the latest appliances for handling material. He was called upon to advise the leading corporations in Scotland, and was much in demand as an expert witness, both in Scotland and at Westminster. He contested East Lothian unsuccessfully three times. He was chairman of the Edinburgh and District Tramways Company, director of the National Bank of Scotland and of the Edinburgh Life Insurance Company, and governor of the Merchiston Castle Schools and of the Royal Hospital for Sick Children. He is survived by an only daughter.

BOTANICAL science has suffered a serious loss through the death of Ruth Holden, an American botanist of great promise. Miss Holden was born at Attleborough, Massachusetts, in 1890, and graduated M.A. of Harvard in 1912. She took up palæobotanical research under Prof. Jeffrey, of Harvard, and in 1913 came to this country as a travelling Harvard fellow in order to devote herself more particularly to the anatomical investigation of Mesozoic Conifers. She became a post-graduate student of Newnham College, and was afterwards elected to a fellowship. Impelled by her love of strenuous work and by her strong conviction of the justice of the cause of the Allies, Miss Holden temporarily relinquished her scientific career at the Cambridge Botany School and threw herself with characteristic energy into nursing. In December last she went to Russia with the first of the Millicent Fawcett medical units, and earned the unstinted praise of the administrator of the unit by her self-sacrificing work in Petrograd, Kazan, Galicia, and in various parts of Russia. After partially recovering from an attack of typhoid fever, she died from meningitis at Moscow on April 21. Miss Holden had published several papers on palæobotany, both in America and England, and shortly before her departure for Russia she completed an account of a new Cordaitalean genus from India. She was an exceptionally keen and able investigator, who endeared herself to all with whom she was associated by her outspoken candour, her sense of humour, and her wonderful power of overcoming difficulties, both in the way of fulfilment of her plans of scientific work and in surmounting obstacles which confronted her in her endeavours to obtain employment as an American citizen with a British medical unit.

MR. J. V. DUPRÉ, whose death we regret to record, had a distinguished scientific career, and did much valuable work in connection with explosives. After leaving Merchant Taylors School, he took the three years' course in engineering at the City and Guilds of London Technical College, South Kensington, and gained the college diploma. After leaving college he worked for about a year in the laboratory of the late Dr. A. Dupré, F.R.S., where he gained his first experience of explosive work, in which he evinced the greatest interest. He then obtained an entrance into Messrs. Vickers, Ltd., and went through their shops at Erith, afterwards working for six years in their drawing office at Westminster. During the whole of this time he lived with his brothers, then chemical advisers to the Explosives Department of the Home Office, having succeeded their father in this position, and thus kept in closest touch with explosive chemistry, practical and applied. He then went to Canada, where he worked as chemical assistant to Dr. Lynde, of the McGill University, at St. Anne's. Soon after the outbreak of war he obtained an appointment in connection with the Explosives Department of the Munitions Board, Canada, and superintended the erection and working of a number of explosives factories in various parts of Canada. In all this work he showed such a grasp of his subject that in October, 1916, he was appointed chief chemical adviser, and finally technical adviser also, posts he filled with the greatest success. During January of this year he had a serious breakdown owing to overwork, and on convalescence was sent by the board to Old Point, Comfort, Virginia, to recuperate, but caught a chill on the journey, which developed into rheumatic fever, and finally into pneumonia, which ended fatally on March 13.

FEW men were so well known in pharmaceutical circles, and few so highly respected, as Mr. Peter MacEwan, who died on May 16, in his sixty-first year, and for the past eighteen years had held the responsible post of editor of the *Chemist and Druggist*. Mr. MacEwan received his pharmaceutical training in Scotland, and evinced very early in his career a distinct inclination towards the scientific side of pharmacy. When only twenty-six years of age he was appointed secretary in Scotland of the Pharmaceutical Society, and in that capacity found time and scope for the development of his scientific tendencies and ability for organisation. After a comparatively short time he joined the editorial staff of the *Chemist and Druggist* in London, succeeding the late Mr. A. C. Wootton in 1899. He published numerous papers dealing chiefly with the chemical aspect of pharmaceutical problems, and also devoted much attention to pharmaceutical politics. His judgment was keen and accurate, and his criticisms of the prevailing policy were frequently advanced with remarkable vigour. There was scarcely a branch of pharmacy in which he did not possess some special knowledge, and, being one of the kindliest and most generous of men, an appeal to him for assistance in any subject was seldom made in vain. He was a constant attendant at pharmaceutical meetings, and his contributions to the discussions almost invariably threw new light on the subject under consideration. His health had been for some time indifferent, but his death, which was due to apoplexy, was sudden. The funeral, which took place on Saturday last at Marylebone Cemetery, Finchley, was attended by many well-known pharmacists, including the president and registrar of the Pharmaceutical Society, and also by representatives of other learned societies. By his death pharmacy has sustained a distinct loss, and his absence from pharmaceutical gatherings will be painfully felt.

We are indebted to the *Lancet* for the following extracts from an obituary notice of Prof. Landouzy, whose death, on May 10, after a long illness, we announced last week. Louis T. J. Landouzy was born at Rheims in 1845, the son and grandson of medical men. Beginning his studies in the place of his birth, he went to Paris in 1867 to complete them, becoming hospital resident in 1870, and steadily ascending the professional ladder until his appointment as physician to the Hospital Laennec in 1890. Three years after this he accepted the chair of therapeutics at the faculty of medicine in Paris, bringing with it the membership of the Academy of Medicine. In 1907 he was chosen by the faculty to be its dean, and in 1912 he was elected a member of the Institute. His most recent honour was the award of a gold medal for his work on infectious diseases by the Ministry of the Interior. Landouzy had long become one of the familiar figures of contemporary medicine both in France and abroad. Endowed with a great capacity for work, associated with remarkable physical activity, he accomplished a very large amount of scientific work bearing on a variety of important questions. But it is in connection with tuberculosis that his name will be best remembered. In the struggle against tuberculosis as a social disease Landouzy was ever to the front. He was delegate to the several international congresses on tuberculosis, and at Washington in 1908 expressed the belief that the centenary of Pasteur would witness the final extinction of tuberculosis. If he had lived to complete it, his last work would have been devoted to the organisation of an anti-tuberculosis campaign in the Army and to the invaliding of the tuberculous soldier. He was present in London at the last International Medical Congress of 1913, when he read a paper on thermal treatment and spoke as the official delegate at the dinner given by Lord Beauchamp on behalf of the British Government.

During the winter months, as Mr. Miller Christy has stated in a recent paper (Quart. Journ. Roy. Meteor. Soc., vol. xlii., 1916, pp. 269, 275), the sound of gun-firing in Flanders and France is rarely heard in the south-east of England. The conditions are now becoming favourable to audibility. According to a correspondent of the *Times* (May 14), the air-waves resulting from the heavy bombardment of Zeebrugge on the morning of May 12 were heard and felt to an unusual degree at Dover, Deal, and other places on the south-east coast. Dover lies eighty miles to the west of Zeebrugge, and there was a light north-easterly wind at the time. Yet "residents in villages several miles inland were awakened by the noise, the houses on the higher ground especially feeling the vibration." We have also received an interesting letter from Dr. H. C. L. Morris, of Bognor, in which he states that the sound of distant gun-firing was heard at that place, while he was out of doors, from 11 to 11.30 p.m. on May 13. He describes the sound as "a continuous rapid vibratory percussion, coming up from the south-east. . . . The sounds varied in intensity, and as near as I could judge a hundred distinct reports were heard to the minute. There was a very light land breeze from the north-west at the time." The sound-waves evidently came from a very distant source, possibly from the neighbourhood of Arras, which is 160 miles from Bognor.

On April 2, 1916, shortly after 2 p.m., a great explosion occurred in a munition factory at Faversham. Several references are made to this explosion in the descriptions of the East London explosion of January 19. The observations are all from places to the north of Faversham. The sound of the explosion was heard at Maldon (30 miles), Dunmow (45 miles), and Little Bardfield, near Braintree (49 miles)—all places in the silent zone of the East London explosion; also at Diss (75 miles) and Norwich (92 miles). The air-waves shook windows at Little Bardfield, Felsham (60 miles) and Elmswell (64 miles) near Bury St. Edmunds, and Newmarket (68 miles)—in the silent zone of the East London explosion; also at Ufford, near Woodbridge (60 miles), Diss, Wrengham (88 miles) and Haddiscoe (89 miles) near Norwich, Norwich, and near Aylsham (104 miles). There is no evidence of a silent zone in this explosion, but the number of observations summarised above is, of course, too small either to prove or to disprove its existence.

It appears from the annual report of the Decimal Association for 1916, which has just been received, that considerable progress was made during the year in the movement for the decimalisation of the coinage and weights and measures. Numerous representative public bodies have passed resolutions in favour of the proposals; as, for example, the executive council of the County Councils Association, which has expressed the view that it is desirable in the interests of education, commerce, manufactures, and trade that the decimal system of coinage and weights and measures should be as speedily as possible brought into general use in the United Kingdom, and that the system should be introduced into the curricula of the various schools as a necessary part of arithmetic. In this connection it may be mentioned that the Incorporated Association of Headmasters has also invited its members to support the proposals, and that the Lancashire and Cheshire division of that body has formed a committee for the purpose of suggesting ways of discovering and overcoming existing objections to the introduction of the metric system. British consuls abroad have continually directed attention to the necessity of adopting the metric system, and to the loss of orders and contracts involved in the retention of our present weights and measures. The recommendations of the Dominions Royal Commission were very sympathetic as regards the metric system of weights and measures and decimal coinage. The Commission was of opinion that the termination of the war would bring with it an unequalled opportunity for securing this much-needed reform, and that the Imperial and Colonial Governments should then co-operate to establish throughout the Empire a uniform coinage based on the decimal system and uniform weights and measures based on the metric system.

The Philadelphia Museum has recently acquired a collection of specimens of the arts and crafts of the Bagobo, a people inhabiting the mountains of Mandanao, between the crest of the range which culminates in the volcanic Mount Apo, the highest peak in the Philippines, and the waters at the western side of the head of the Gulf of Davao. This is described by Mr. R. W. Hall in the *Museum Journal*, vol. vii., No. 3, for September, 1916. In December, when Orion appears in the sky, there is a magical ceremony intended to promote the growth of rice, their staple food. Though the fact has been questioned, there seems little doubt that at this sowing rite a slave victim was bound and his body hacked in pieces by the celebrants. It does not appear that, as in the Khond rite described by Sir J. Frazer, the flesh was actually buried in the fields. But this was possibly part of the rite in its primitive form.

In the *Indian Journal for Medical Research* for January (vol. iv., No. 3) Capt. Knowles and Capt. Cole publish a study of the entamœbic cysts of in-

testinal amœbæ of man. They point out that divergent views exist as to (*a*) the differentiation of species of intestinal amœbæ, (*b*) the pathogenicity of the different species, and (*c*) the differentiation of species when encysted. They state their principal conclusions as follows: *Entamoeba tetragena* is usually regarded as identical with *E. histolytica*, and our results confirm this view. *E. minuta* is usually regarded as the pre-cyst of *E. histolytica*, whereas we have found *minuta* forms associated with both *E. coli* and *E. histolytica*. Where the prevalent type of organism was *E. minuta* it was commonly in association with 8-nucleate cysts, and resembled *E. coli*. We believe that these "different species" are all one and the same organism. The paper is illustrated with two excellent coloured plates.

The method of measuring a small electric current, as, for example, the ionisation current through a gas, by the rate of leak of the charge on an electrometer through a known high resistance, has proved so convenient that many experimenters will welcome a paper by Dr. W. F. G. Swann and Mr. S. J. Mauchly on a method of constructing a high resistance of the Bronson type, for which Ohm's law is applicable, which appears in the March number of *Terrestrial Magnetism and Atmospheric Electricity*. A small quantity of ionium, which was chosen as the most suitable radio-active material, is placed in a shallow depression in the upper face of a brass plate and covered with sheets of mica and silver foil. The plate rests on the bottom of the ionisation chamber, through the top of which an insulated tube carrying a circular electrode projects. Through this tube a rod passes which carries a smaller plate, and the distances of both plates above the ionium plate can be varied. The metal surfaces within the chamber are all silver-plated. When the upper plate is 4·6 cm. and the lower 1 cm. above the ionium plate, the resistance of the cell is constant up to a potential difference of 4 volts, owing to the usual decrease of conductivity being compensated by the action of the δ rays from the metal surfaces.

In the adoption of any scheme which runs counter to habits and prejudices, and with which obvious advantages and disadvantages are connected, as in the substitution of "Summer Time" for the normal and uniform method of time reckoning, many suggestions will be made with the view of improving the mechanism and diminishing the inconveniences. M. Désortiaux, of Tulle, a retired French engineer, is early in the field with a pamphlet, "La Réforme rationnelle de l'heure" (Gauthier, Villars), urging some drastic proposals that seem calculated to make confusion worse confounded. He objects to the abrupt alteration of the clock-hands twice a year, involving sudden interruptions of time-reckoning, and recommends a number of small alterations, the maximum being seven minutes, which he thinks could be introduced imperceptibly and without dislocation of our habits, by arrangement with the railways and other public indicators of time. In each week of January the clock is to be advanced five minutes. On two days of each week in February, April, and May the clock will be accelerated six minutes, and in March seven minutes. In June there will be no alteration, and in the second half of the year there will be retardations of similar amount, to restore the clock time to normal condition in January. The alteration effected by these small increments is far more considerable than in the plan that has obtained legislative sanction. The accumulative effect at maximum is 3·57 hours, one object of the ingenious proposer being to make the watch indicate approximately the same hour at sunrise. This arrangement discloses one weakness of the plan. It takes no account of latitude, and though the author admits the necessity of agreement between countries that have conterminous borders, he does not consider that the inhabitants on the Belgian border would be differently affected from those on the Italian. Again, it is strange that one who clearly perceives the annoyance caused by the sudden change of an hour, with its tendency to disarrange transport services, can suppose that a long-suffering public would endure a series of irritating interruptions twice a week for many months of the year. But having sanctioned a tampering with the uniform record of time, many utterly impracticable methods will be proposed with the benevolent intention of reducing the inconvenience to a minimum.

In the April issue of the *Quarterly Review* will be found a well-informed article by Prof. W. J. Ashley on German iron and steel treated from the point of view of its commercial as distinct from its technical development. The syndication movement in Germany began to achieve continuous and substantial success when in 1892 the pig-iron producers came together, and in 1893 the Westphalian Coal Syndicate was formed. This example was followed by various branches of the steel trade. These combinations began with a mere price agreement; then they had to apportion the sale; and afterwards they concentrated the marketing of their commodity in a common selling organisation. Prof. Ashley then traces the further development of these "cartels" and their amalgamation into the "Stahlwerksverband," the great Steel Syndicate, which has commanded the whole position ever since. In order effectively to regulate price it limits each of the constituent concerns to a prescribed quota of a defined total output and concentrates all the sales in a central office. The growing cost of plant makes it very difficult for new competitors to start up from outside. In Germany the experts consider that no new steel works can profitably be put down which have an output capacity of less than 400,000 tons. Finally, the system of bounties payable to home manufacturers in respect of their export trade is explained.

The formation of "ground ice," or "anchor ice," at the bottom of running streams occurs sometimes in this country, and forms the subject of an article in *Engineering* for May 11, by Mr. J. MacAlister, assistant engineer at the Greenock Waterworks. Ground ice has been experienced at Greenock in the "Cut," an open aqueduct some five miles long and situated about 500 ft. above sea-level. The water has a velocity of about 3 ft. per second, and ice sometimes forms at the bottom, thereby raising the surface-level of the water. Careful watching is required, as the slabs of ice sometimes take up such positions during the process of release as lead to overflow of the water. Despite other theories, Mr. MacAlister is inclined to think that the formation of ground ice in this channel, which has a rough bottom, is due to the cooling of the whole mass of water and the ice first forming in the comparatively still water encountered in the lee of stones, etc. The process may be, and probably is, accelerated by radiation, as the portions of the aqueduct where the ice usually forms first are situated at comparatively open spaces, and have low banks. Towards the end of January this year, for the first time in the history of some of the reservoirs, the formation of ground ice was general throughout the Greenock Waterworks. The author describes the various measures taken to remove the consequent ice blockages.

OUR ASTRONOMICAL COLUMN.

TWO ECLIPSING VARIABLE STARS.—The eclipsing variables RV Ophiuchi and RZ Cassiopeiæ have recently been investigated in great detail by R. S. Dugan (Contrib. Princeton Observatory, No. 4). In RV Ophiuchi, which is of spectral type A, the brighter star is found to emit five times as much light as the other, though having only two-thirds the diameter of the fainter component. During the total eclipse at primary minimum the star is 2·03 mag. fainter than at maximum, while the loss during the annular secondary minimum amounts to 0·11 mag. On the supposition of equal masses, the densities of the brighter and fainter components are respectively 0·24 and 0·06. In RZ Cassiopeiæ, which is also of spectral type A, the eclipse at primary minimum is not total, only eight-tenths of the smaller brighter component being covered by the larger fainter component, the star then being 1·59 mag. fainter than at maximum. At secondary minimum the loss of light is 0·06 mag. The smaller star emits seven times as much light as the larger, and its surface brightness is twelve times as great. The distance between the centres is three and a half times the radius of the fainter star, and probably between five and six times the radius of the sun. The brighter component is from two and a half to six times as dense as the fainter.

The new elements for the occurrence of eclipses in the two stars are:—RV Ophiuchi, 1913, Feb. 9d. 19h. 33·4m. + 3d. 16h. 29m. 27·75s. E − 2m. sin 0·22° E; RZ Cassiopeiæ, 1906, May 24d. 10h. 6·0m. + 1d. 4h. 41m. 9·6s. E + 10m. sin (12° + 0·068° E).

Mr. Dugan points out that every eclipsing variable which has been observed with sufficient care and persistence shows a measurable secondary minimum, indicating that the companion is always a luminous body.

NEW ZEALAND TIME SERVICE.—Mr. C. E. Adams, the Government Astronomer for New Zealand, has recently issued particulars of the new arrangements which have been made for time-signals at the Hector Observatory. Accurate time-signals are given by three electric lights mounted vertically on the observatory flagstaff; the lowest light is green, and is 30 ft. above the ground; the middle light is red, and is 36 ft. above the ground; the highest is white, and is 42 ft. above the ground. The green, red, and white lights are switched on at fifty minutes, ten minutes, and five minutes to the hour respectively, and the signal is given by extinguishing all three at the exact hour. The signal is given in this way at G.M.T. 20h., 21h., and 22h., corresponding to New Zealand civil mean time 19h. 30m., 20h. 30m., and 21h. 30m. Arrangements have also been made for providing time-signals by telephone, telegraph, or wireless telegraph.

STONYHURST COLLEGE OBSERVATORY REPORT.—The results of the astronomical, meteorological, and magnetical observations made at Stonyhurst College Observatory during 1916 have been issued in the usual form by the Rev. Father Sidgreaves. The various observations are conveniently tabulated, and interesting comparisons with previous records are given. The solar surface was observed on 215 days, and the mean disc area of the spots, in units of 1/5000th of the visible surface, was found to be 4·52, as compared with 4·51 for 1915, 0·82 for 1914, and 0·04 for 1913. Detailed drawings of faculæ were made on twenty-nine days during the summer, and it is hoped that these may be of value for comparison with spectroheliographic records in hydrogen and calcium light. The spectrum of *o* Ceti was photographed at the two maxima which occurred during the year. The duration of bright sunshine was 205 hours short of the yearly average.

CONTINUED AND SPECIALISED EDUCATION IN ENGLAND AND WALES.

THE Board of Education has taken advantage of the widespread interest in education awakened by the events of the war to consider in what measure, by a reconsideration and a revision of its regulations, it can encourage a much fuller development of further education in its various forms, especially in those which fall outside the sphere of the secondary school and of the university.

The Board has accordingly had under review the facilities for further education which, since and prior to the Education Act of 1902, including the results of the Technical Instruction Act of 1889, which was almost entirely responsible for the establishment of technical schools in the kingdom, have been provided by the local authorities, and it has accordingly issued a "Draft of Proposed Revised Regulations" upon which suggestions and criticism are invited. The draft embodies the experience and results of what in large measure is already to be found in successful operation, especially in the vigorous industrial centres of the North, where already in several of the large county boroughs there exists in full and successful activity the chief feature of the scheme set forth in appendix i. of the draft, entitled "A Suggested Plan for Further Education in a County Borough."

The draft gives an admirable *résumé*, especially in its four appendices, of the measures it is desirable to adopt to meet the educational necessities of not only the county boroughs, but also of other areas, such as the smaller towns and the urban and rural areas, and having regard to the different conditions, agricultural, industrial, and commercial, which prevail, including the provision of facilities "for disinterested studies making for wise living and good citizenship."

The draft foreshadows a more liberal policy on the part of the Board in respect of the administrative working of the measures for further education and of larger subsidies from the taxes. It is high time that the Board left a larger freedom in the hands of the local authorities by the removal, as it would appear is the intention of the Board, of many vexatious restrictions in their regulations, which entail a vast expenditure of time, both locally and centrally, upon the authorities out of all proportion to any advantage to be gained.

The proposed grant per *teacher*-hour instead of per *student*-hour is a most desirable reform, as is the substitution of inclusive and block grants in lieu of grant per student or per subject, and of much simpler methods of registration.

It is, moreover, a wise proposal that in the future the local education authority is to have full responsibility, as indeed the terms of the Act of 1902 require, for the educational efficiency and the proper and effective administration of all the facilities for further education within its area, whether rate-aided or not, and upon it is to devolve many matters of detail hitherto undertaken by the Board. Provisions are made whereby neighbouring local education authorities are encouraged to co-operate in certain educational measures so as to avoid waste of money and effort. The status and position of the larger and more advanced schools, as is now the case with a few, are to be more fully recognised by the Board under the new title of local colleges, and instead of being aided piecemeal in respect of the different courses of work undertaken by them, the colleges will be paid in regard of all their work by a block grant, and be recognised as "the centre and crowning limit of the local system of further education." The Board, it is of importance to note, "is fully satisfied that if any material advance is to be made it is only equitable that an increased

proportion of the cost, both of much old work and of new developments, should fall upon the grants."

The important changes set forth in the draft await, however, in their main proposals the close of the war, but having regard to the admitted fact that more than two millions of the adolescent population between thirteen and eighteen years of age cease to avail themselves of all opportunities of further education, no measures will be really effective for the future education of the young people until all exemptions from school up to at least fourteen years of age are removed and provision made for continued education within working hours until eighteen years of age. It is to be hoped, as the Board desires, that the experienced administrators of the various authorities and the teachers will give careful consideration to this important manifesto of the Board.

THE SUPPLY OF CEREALS.

THE recently published "Statistical Notes on the Cereals" (No. 5, March, 1917) issued by the International Institute of Agriculture must be regarded in the existing situation as a compilation of more than ordinary interest, representing as it does the most precise information obtainable as to the results of last season's corn harvests throughout the world. Preliminary estimates issued from time to time have pointed with lamentable uniformity to a serious shortage of corn supplies as compared with recent years, and the final record fully bears them out. Interest centres specially in the yield of cereals available for international trade, which excludes enemy countries, territories invaded by the enemy, and countries such as the uninvaded portions of Rumania and European Russia, export from which is prevented by the war. The total yield of wheat from all other sources shows a decline of 27·7 per cent. as compared with the excellent harvest of 1915, and 16·9 per cent. as compared with the average of the five seasons 1911–15. The rye crop shows corresponding deficiencies of 2·9 per cent. and 4·1 per cent.; barley, 9·9 per cent. and 4·1 per cent.; oats, 6·9 per cent. and 3·2 per cent.; and maize, 15·9 per cent. and 12·1 per cent. respectively. Taking wheat and rye together as the staple bread-corn crops, the total deficiency as compared with 1915–16 is 26·3 per cent., or 16·1 per cent. below the five-year average, whilst the total of the three "fodder-corn" crops shows corresponding deficiencies of 15·5 per cent. and 8·8 per cent. respectively. Now that all corn has become bread-corn the grand total is of interest, and this shows deficiencies of 19·6 per cent. and 11·4 per cent. respectively.

In order to get a true picture of the balance between production and consumption it is necessary, however, to bring further into the account the "carry-over" from previous seasons' crops, which fortunately in the case of wheat, oats, and maize was large. Even then, however, the available supplies fall short of estimated normal consumption for every crop except oats. In the case of wheat the whole supply of crop and reserve fails to meet normal consumption by roughly 2 per cent., whilst the total supplies of grain of all kinds show a deficiency below consumption requirements of fully 3 per cent. These deficiencies may appear to be small, but it must be remembered that they involve the entire consumption of the remainder left on hand from the superb crop of 1915 and leave absolutely no margin of insurance against a further unfavourable crop in the current season. When we make allowance further for the large quantities of corn which must have been lost on the high seas, it must be admitted that the case for a drastic reduction in cereal consumption has been proved beyond challenge.

TESTS FOR GLANDERS IN ARMY HORSES.

UNDER the title "The Value of the Intra-dermo Palpebral Method of Malleinisation," Major Hobday has recorded in the *Veterinary Journal* for December, 1916, his experience concerning the value of the palpebral test for glanders in horses, as employed in the French Army by Vet.-Major Lamarque, Prof. Douville, and M. Drouin. After a very extensive application of the test, he is very favourably impressed with it, claiming several advantages for it as compared with the subcutaneous test carried out in the region of the neck more widely resorted to in this country.

The chief advantages claimed are especially notable where large numbers of horses have to be speedily tested, and are summarised by Major Hobday as follows: (1) The greater convenience of transport (since the required dose is so much smaller); (2) the ease and rapidity of administration; (3) the great advantage of visibility (since swelling in the region of the eyelids is so much more perceptible than swelling in the subcutaneous region of the neck); (4) that the reaction is more violent and more rapid, and no time is wasted by taking temperatures, which is unnecessary; and (5) that the cost is less, owing to the smaller dose used.

For the test concentrated mallein is used, and two minims are injected with antiseptic precautions "intradermally in the under-eyelid, about the centre, but slightly inclined to the inner canthus." The eyes are inspected in about twenty-four hours, and again in about thirty-six or forty-eight hours, after injection. A positive reaction consists of a discharge of mucus from the inner canthus, and a characteristic swelling of one or both eyelids, closing up the orbit to a greater or less degree, and being excessively tender. The swelling, which persists for three or four days, extends downwards over the submaxillary region, and there may be a cording of the lymphatics extending to the submaxillary gland, which is swollen and tender. This test for glanders is undoubtedly of great value when large numbers of horses have to be speedily inspected, but whether it will prove as efficient or as generally trustworthy as the older subcutaneous test, in which the local reaction is accompanied by a thermal reaction which serves as a check, remains to be proved.

RHUBARB.

"IT is the interest of Mankind that all persons should be caution'd of advent'ring upon unknown herbs and plants to their prejudice." These words, written by John Ray more than two centuries ago, and quoted by his distinguished contemporary, John Evelyn, in his "Acetaria," are seasonable still, and, indeed, in view of the recent "advent'ring" with regard to rhubarb-leaves, have to-day a special significance and interest. Were our famous countryman of Stuart times living at this hour, it is quite conceivable that, great experimentalist as he was, and endowed with more than the usual share of the "interest of Mankind," he would have devoted himself with energy and skill to the solution of some of the problems that confront us now, and some pertinent remarks on the question of utilising rhubarb-leaves as a vegetable would have been likely to appear over his signature in the columns of the daily newspapers. Had he in such circumstances recommended them, we can well imagine that his recommendation would have been accompanied by a warning similar to that quoted above, or more cogent, and printed in large clarendon capitals or italics.

An appeal has been made to history to supply an authority for consuming rhubarb-leaves now, and some prominence has been given to the statement which reposes in some books of considerable authenticity that they were used as a pot-herb in Queen Elizabeth's time. If they really were so used, and even with perfect safety, and were then "considered to be superior to spinach or beet," it is poor comfort to offer to those who in 1917 are suffering the tortures of poisoning arising as a consequence of eating them. That numerous cases of more or less serious illness, and at least one fatality, as reported within the last few weeks in the daily Press, have followed the eating of rhubarb leaf-blades, is accepted as a fact which should leave no doubt in one's mind that they form to many people an unwholesome and even a dangerous food.

In inquiring into the use of rhubarb, mainly with the view of getting evidence from the records of the past as to the use of its leaves as a vegetable, and what were the opinions held regarding such a practice by those who have gone before, some notes which here and there may contain fragments of interesting and useful information have been accumulated, and may be worth putting on record in a collected form.

It is not intended to go far into the botany of rhubarb. The vexed question of the source, or sources, of medicinal rhubarb has led to much controversy. That does not concern us here. The rhubarb used for culinary purposes to-day appears to have originated from more than one species. Some writers attribute its origin to *Rheum Rhaponticum*, Linn., and there seems no reason to doubt that it was this species that was first used in this country for culinary purposes, as well as being the first grown in England for its medicinal root. Moreover, it was the first species introduced into cultivation here, and from early times has been known as English rhubarb. Another species believed to be the parent of culinary rhubarb is *R. undulatum*, Linn., introduced in 1734, while *R. hybridum*, Murr., which, according to Aiton, was introduced in 1763 by Dr. John Hope, F.R.S., who had a garden at Upton, West Ham, is claimed by some authors as the original source of the common garden rhubarb of to-day. All three, and probably other species, are involved in its parentage. For many years it has been cultivated in many varieties differing in size and colour of leaf-stalks, flavour, and in degree of earliness.

Evelyn did not appear to know the rhubarb plant. He does not allude to it in his "Acetaria." Nor can we get any evidence from other writers of his time to support the reiterated statement that *Rheum Rhaponticum* was introduced in 1573, and our investigations induce us to say that whatever else flourished in this country in Queen Elizabeth's reign no species of Rheum had any chance at all, for none was in the gardens of her day. Whatever delights and good times the Elizabethans had, they owed nothing to a dish of stewed rhubarb or a rhubarb-tart, and whatever bad times—whatever pains they endured—could not be laid to the charge of rhubarb-leaves in any form. The delights arising from the former were reserved for a much later, if not more fortunate, generation, and the tortures arising from the latter for our more immediate forefathers in some degree, but chiefly for ourselves.

We have suggested that the statement that rhubarb-leaves were used as a pot-herb in Queen Elizabeth's time cannot be trusted. It is apparently based on a mistake which originated out of a confusion of terms. John Gerard described and figured a certain plant in the first edition (1597) of his famous "Herball," under the name of *Hippolapathum sativum*, Patience, or Munkes (Monkes) Rubarbe, the last name "bicause as it should seeme some Monke or other have used the roote heereof in steede of Rubarbe." This, he says, "is an excellent holsome potherbe," but "it is not so pleasant to be eaten as either Beetes or Spinage." There is no doubt whatever that this plant is not a true rhubarb, but is a dock, and has been rightly referred by careful writers to *Rumex Patientia*, Linn., Herb Patience, a native of Southern Europe and the Orient. The name, "Monk's rhubarb," has also obtained currency in many works, including Syme's edition of "English Botany," for *Rumex alpinus*, Linn., a dock with large, roundish, radical leaves, found occasionally in this country, presumably as an escape from cultivation. This plant was known to Gerard, who included it in his "Herball" under the name of *Hippolapathum rotundifolium* (Bastarde Rubarbe), and he cultivated it in his garden in Holborn. Both these docks were evidently in gardens of the sixteenth century, and possibly long before, and were cultivated as pot-herbs, or the latter, according to Gerard, as a medicinal plant. Medicinal rhubarb was known to Gerard, but evidently only in the form of the dried root, which he figures. No evidence has been discovered to prove that any species of the true rhubarb (Rheum) was in cultivation in England before early in the seventeenth century, when John Parkinson, some time (probably not many years) before 1629, obtained a plant of what is now regarded as *Rheum Rhaponticum*, Linn. This he cultivated, and it is figured and described in the first edition of his "Paradisus Terrestris," 1629, under the name of *Rhaponticum verum seu potius Rhabarbarum verum*. Of it he wrote:—"I have a kinde of round leafed Dock growing in my Garden, which was sent me from beyond Sea by a worthy gentleman, Mr. Dr. Matth. Lister, one of the Kings Physitians, with this title, *Rhaponticum verum*, and first grew with me, before it was ever seen or known elsewhere in England." After some reference to the character and medicinal properties of the roots, he continued:—"The leaves have a fine acide taste. A syrrupe therefore made with the juice and sugar, cannot but be very effectuall in dejected appetites, and hot fits of agues; as also to helpe to open obstructions of the liver, as divers have often tryed, and found availeable by experience."

By some curious blunder Monk's rhubarb has also been identified with *Rheum Rhaponticum*; hence in many works it is stated that this plant was introduced in 1573, apparently on no better evidence than is supplied by the fact that Tusser included the name "rubarb" in his "Five Hundreth Points of Good Husbandry" of that date. In the edition of 1672 this name, without any qualification whatever, occurs in a list under the heading, "necessary herbs to grow in the Garden of Physick, not rehearsed before." This "rubarb" is probably *Rumex Patientia*, or *R. alpinus*—in "English Botany" it is represented as the latter. It is practically certain that it was not *Rheum Rhaponticum*.

It will be noticed that Parkinson refers to the fine acid taste of the leaves of the rhubarb which he cultivated. It is not clear whether he was alluding to the leaf-blade or leaf-stalk, but apparently he viewed this plant only as medicinal, and it seems impossible to determine the approximate date when rhubarb was first used for culinary purposes as we use it to-day. The practice of so using it was known to Philip Miller in 1752, for in the sixth edition of his "Gardeners' Dictionary" he wrote:—"This sort [*Rheum Rhaponticum*] is frequently cultivated in the gardens, and is call'd English Rhubarb. The roots of this enter as an ingredient into several compound medicines; and of late years, the footstalks of the leaves have been used for making of tarts in the spring of

the year, as these may be had before gooseberries are large enough for that purpose. These footstalks must have their outer skin peel'd off, otherwise they will be very stringy: when this is done, the pulpy part will bake very tender, and almost as clear as the apricot; and having an agreeable acid flavour, is by many persons esteemed for this purpose."

Rheum Rhaponticum has been cultivated in the neighbourhood of Banbury, mainly for the sake of its root, since about the year 1777. W. Bigg, writing in 1846 (*Pharm. Journ.*, vol. vi., p. 75) on its cultivation there, said:—"Of the leaves, I believe no use is now made, except the use common to all vegetable offal—manuring. The leaf-stalks are now very partially sold for the table. In former years, the sale of the leaf-stalks formed a part of the trade, but it can scarcely be said to do so now. Wine has been occasionally made of them, but not to any important extent. . . . The leaves were some years ago in demand (I have reason to think) for the adulteration of tobacco, or the manufacture of cigars, but are not at present."

It is stated in *Loudon's Gardeners' Magazine*, vol. vii., 1831, p. 369, that poor people in the neighbourhood of Glasgow were in the habit of using rhubarb-leaves as a remedy for, or for the relief of, rheumatism. Heated leaves were applied to the parts affected.

If there was anything like a general appreciation of rhubarb as a substitute for fruit about the middle of the eighteenth century it must have declined so much in favour as to have been little used at the beginning of the nineteenth, for it is recorded that Mr. Joseph Myatt, of Deptford, about the year 1810, sent his two sons to the Borough Market with five bunches of rhubarb, and of these they succeeded in selling only three. But he persevered in his efforts to make a market for the vegetable, raised improved varieties, and before many years had elapsed rhubarb as a culinary plant was established in public favour. According to *Loudon's Gardeners' Magazine*, vol. iv., p. 245, at the beginning of June, 1828, the demand for rhubarb in the Newcastle-upon-Tyne market was so considerable that 100 sticks sold for 5*s*. In 1831 (*loc. cit.*, vol. vii., p. 682) the culture of tart-rhubarb had increased so rapidly about Edinburgh that one grower for the market, who a few years before found great difficulty in selling forty or fifty dozens of bunches of stalks in a morning, sold from three to four hundred dozens of bunches. The common price of tart-rhubarb in the Edinburgh market at that time was 2*d*. a bunch of a dozen stalks, while in Glasgow the same quantity was sold for 3*d*.

We are informed that Myatt obtained his first roots from Isaac Oldaker, gardener to Sir Joseph Banks, and Oldaker had brought them from St. Petersburg, having been gardener to the Emperor of Russia. They represented a finer and earlier kind than those previously cultivated in English gardens.

Several papers in the Transactions of the Horticultural Society of London show that in the second and third decades of last century a great deal of attention was paid to the forcing and blanching of rhubarb. In 1824 Mr. James Smith, gardener at Hopetoun House, was awarded the society's silver medal for devising a simple, effectual, and economical mode of forcing the plant. It appears that the method of blanching was discovered by accident in the Chelsea Physic Garden in 1815 (Trans. Hort. Soc. Lond., vol. ii., p. 258).

It was long ago realised that the use of rhubarb as food was attended with some risk to health. Lindley ("Vegetable Kingdom," 1846, p. 503) remarked that oxalic acid is copiously formed in both docks and rhubarbs, and that the latter also contain an abundance of nitric and malic acids. While these give an agreeable taste to the stalks of rhubarb when cooked, he regarded them as being ill-suited to the digestion of some persons. The "Penny Cyclopædia," 1841, warned persons subject to calculous complaints against eating tarts made from rhubarb leaf-stalks, owing to the presence of oxalic acid, and that "the formation of the oxalate of lime, or mulberry calculus, may be the consequence of indulgence."

A note in the *Gardeners' Chronicle*, 1846, p. 5, by Alexander Forsyth, who was gardener to the Earl of Shrewsbury at Alton Towers, Staffordshire, has been recently referred to in newspapers as showing that rhubarb-leaves were in use about that time for culinary purposes. Forsyth wrote:—"We have been in the habit of eating the leaves of the rhubarb-plant for many years, and seeing that the fruit-stalks of this vegetable were counted as waste, I thought it very likely that they were the better part of the plant, and I now find that the pouches of unopened flowers bear the same relation to the leaves of rhubarb that cauliflowers do to cabbage-leaves, and may be obtained in great abundance, and that at a time (April) when all kinds of vegetables are valuable." He refers to using the young inflorescence, which he called Rhaflower, "as a boiled vegetable, to be used like broccoli." The meaning of his statement about eating the leaves of rhubarb was not clear then, but in a subsequent note (*Gardeners' Chronicle*, 1847, p. 325) there is no doubt at all that by leaves he meant the leaf-stalks, and not the blades, for he wrote:—"I have no experience in the eating of the leaves, and think them nauseous to the taste and unpleasant to the smell, and it seldom happens that any article is good for food when all the three senses of sight, taste, and smell reject it; it is not a good green colour. I tasted them boiled, and they did not appear to me to have one redeeming quality to keep them an instant from the dung-heap." In the latter note Forsyth again referred to eating the cooked flower-heads of rhubarb, and stated that he and others had done so without experiencing any ill-effects. But he directed attention to the fact that during the season (spring, 1847) there was a general complaint against the eating of the stalks of rhubarb-leaves, as violent relaxation had resulted. Another correspondent to the *Gardeners' Chronicle* (1847, p. 325) suggested that illness from eating rhubarb—apparently he meant the inflorescence—may have been due to the variety, and stated that a medical man whom he knew had a plant of rhubarb in his garden which was particularly early, and which, used in tarts, invariably caused illness in those who ate it, while other plants growing in the same bed, but which were a little later, were quite wholesome. The same effects had been observed for several years, until at length he destroyed the offending plant.

A reference to the *Gardeners' Chronicle* (1847, pp. 283, 341, 357) will show the varying results of eating the young inflorescence, producing no ill-effects in some cases and serious illness in others; and in the same journal (1847, p. 283) a case is recorded of a Chelsea woman who boiled rhubarb-leaves as a substitute for spinach, and all three of those who ate of the dish were attacked with sickness, one of them, a boy, being also afflicted with swellings about the mouth. An editorial comment on this runs as follows:—"We are not aware of any similar instances of serious consequences following the use of rhubarb, but it is by no means surprising that a plant which forms so much oxalic acid should be unsafe, and we recommend the subject to serious chemical inquiry. It is quite conceivable that the leaves should contain some principle which the stalks are deficient in, as indeed is proved by the different manner in which the juice of the leaf-stalks and leaves is affected by the

same reagents; but until there shall have been time for a careful inquiry into the organic products of these two parts we can only warn the public against employing for food any part of the rhubarb except that which experience shows to be harmless."

The Garden (1872, vol. i., p. 197) contains an extract from an American paper which shows that a woman residing between Oneida and Durhamville, New York, died from the effects of eating as greens the leaves of rhubarb, or pie-plant as it is known in the United States, her death taking place after three weeks of suffering. "The leaves are poisonous, and should never be eaten," concludes the paper's announcement of the fatality.

Judging from published statements (*Gardeners' Chronicle*, ser. 3, vol. xv., pp. 340, 353, 384, 400), there was a revival of interest in the question of eating rhubarb-leaves in 1899. One correspondent wrote (p. 384):—"Rhubarb-spinach has been for many years a favourite dish with us"; but the Secretary of the Massachusetts Horticultural Society communicated the following warning (p. 400).—"The *Gardeners' Chronicle* for May 27 is at hand this morning and the note on 'Rhubarb-leaves as a Vegetable' prompts me to say to you that instances have been known here where their use as 'greens' has caused fatal results owing to the excess of oxalic acid. A horticultural friend told me many years ago that he had raised many seedlings, some of which (I assume that the usual part was cooked in the usual way) caused vomiting as certainly as ipecacuanha."

A curious case is reported in the *Pharmaceutical Journal* (1901, vol. lxvi., p. 639) as follows:—"At an inquest held at Ashstead on Friday, May 3, concerning the death of John Lintott (thirty-nine), a scaffolder, it was stated that on the previous Monday deceased complained of violent pains and a doctor prescribed for him, having found that he was suffering from a gastric attack. After the doctor left the patient some cooked rhubarb-leaves were given to him as medicine, it being stated that the leaves were used as a vegetable in parts of Hampshire. The man died next day, and the doctor expressed the opinion that death was due to excessive vomiting, causing exhaustion, produced by eating rhubarb-leaves. The coroner expressed surprise at hearing that stewed rhubarb-leaves were used as a medicine or as a vegetable. A verdict was returned of 'Accidental death, caused by eating rhubarb-leaves.'"

In 1911, vol. lxxxvi., p. 8, the same journal contains the following, extracted from the *British Medical Journal* of December 31, 1910:—"The author [Dr. W. E. Burton] mentions two cases of rhubarb-poisoning to which he was called, the symptoms being similar in each case, and refers to the death from the use of rhubarb which was the subject of a coroner's inquest at Catford some weeks since. Rhubarb, although rightly regarded as a wholesome food and an excellent substitute for fruit, does not agree with everyone. It is possible that the presence of oxalates in the urine and the severe intestinal irritation indicate oxalic acid as being one of the agents responsible for the toxic action. Oxalic acid and oxalates, chrysophan, chrysophanic acid, and phaoretin are all found in rhubarb-root, and are of an irritating nature."

In a discussion on rhubarb-wine (*Gardeners' Chronicle*, 1853, p. 406), the observations of one writer seem to have especial interest as a possible explanation of the cause of the variable effects produced by eating rhubarb:—"However good the wine made from rhubarb may be, I take the liberty of advising your readers not to drink it. It is well known that the acidity of rhubarb-stalks is owing to the presence of an acid salt—the binoxalate of potash—a combination of the poison oxalic acid and the alkali potash. This salt does not exist in sufficient quantity in the rhubarb-stalks to produce its poisonous effects, and the same may be said of the wine. But there is another danger attending its use in the form of wine which ought not to be overlooked. All hard water contains lime, and when mixed with the juice of the rhubarb-stalks the binoxalate of potash is decomposed and an oxalate of lime is formed. Now this oxalate of lime is the constituent principle of the mulberry calculus, and there is a peculiar condition of the human body known to medical men as the oxalic diathesis, which depends upon the presence of this oxalate of lime in the blood (I use the word blood for obvious reasons). This oxalic diathesis has been proved by Dr. Golding Bird to be much more common than it was supposed before this gentleman brought the microscope to assist him in his pathological researches. Such being the case, it is obvious that any article of common use which contains this oxalate of lime, or even the oxalic acid or its salts, must be more or less injurious to health, more particularly to those in whom there exists a predisposition to assume the oxalic diathesis. It must be borne in mind that oxalic acid is formed in the human body by the decomposition of sugar, urea, etc., and the diathesis is not uncommon from this cause. If it is thus easily produced indirectly, *a fortiori* it is still more likely to arise from the direct means of rhubarb-wine. Therefore I say to your readers, eschew the doubtless very agreeable beverage which has entered, through the medium of your columns, into competition with genuine 'Sillery mousseaux.'"

The eminent physician and chemist, Dr. William Prout, F.R.S. (1785–1850), regarded rhubarb as likely to be a dangerous food owing to the large amount of oxalic acid present in the leaf-stalks. Having analysed wine made from the stalks, he considered it a most pernicious drink, and that its frequent use was likely to produce stone in the bladder. He expressed the opinion that an Act of Parliament ought to be passed, if necessary, to prevent the sale of so dangerous a poison (*Gardeners' Chronicle*, 1853, p. 438).

There is possibly something in the suggestion that the chemical composition of rhubarb varies to some extent according to the variety and also according to the soil on which it is grown. A writer in the *Gardeners' Chronicle* (1853, p. 357) stated that the amount of water present was less when the plants were grown on poorer soil, while the acid principle was more abundant.

Mr. Edward Solly, F.R.S., published in the Transactions of the Horticultural Society of London, ser. 2, vol. iii., 1848, pp. 35–92, the results of his experiments on the inorganic constituents of plants. Among the numerous plants on which he experimented were several rhubarbs. In the case of each of these he gives the respective amounts of water, organic matter, and inorganic matter found both in leaves and leaf-stalks. In every case, as he shows by figures, there was considerably less water present in the leaves than in the leaf-stalks, but in most cases almost double, in a few more than double, the amount, always very considerably more, of organic and inorganic matter was present in the former. It is therefore natural to assume from the results of his investigations that oxalic acid, or whatever is deleterious in the rhubarb-plant, is present in greater proportions in the leaf-blade than in the leaf-stalk.

It may be left to the discretion of those who chance to read this article to decide whether or not it is advisable to eat cooked rhubarb-leaves or rhubarb in any form. For at least a century the consumption every year of the leaf-stalks as a substitute for fruit has

been enormous. It is well known to be usually a wholesome, and certainly a useful, food. Compared with its extensive use, the cases of illness charged against it may be regarded as negligible. The inflorescence has also been tried, but evidently not very much, and with diverse results. The consumption of the leaf-blades has apparently never been general or considerable, by no means comparable with that of the leaf-stalks, but the baneful effects of doing so are relatively so marked that it may be said decisively that rhubarb leaf-blades cannot be recommended for general use as a food. While experiments in such matters are often necessary, and, if attended with caution, are desirable, carelessness in recommending them or in putting them into practice may place one in a less enviable position than those of whom it has been said, "Happy from such conceal'd, if still do lie, of roots and herbs the unwholsom luxury"; and the injudicious experiment in eating insufficiently tested articles of food may lead one to "discover their malignity in dangerous and dreadful symptoms."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The eighth Halley lecture will be delivered at the University Museum on Tuesday, June 12, at 5.30 p.m., by Prof. Arthur Schuster. The subject is "Terrestrial Magnetism: Past, Present, and Future."

On May 22 Congregation passed the preambles of a series of statutes reconstituting the boards of electors to various professorships, and establishing a committee for advanced studies.

The annual report of the visitors of the University Observatory has been presented to Convocation. In it the visitors express their sorrow at the death of the late Prof. Esson, who acted as secretary to the visitors during the whole forty-two years of the work of the observatory. Several lectures to military bodies have been given by the director (Prof. H. H. Turner), including lectures in France and in the camps on Salisbury Plain. Research has gone forward in spite of unavoidable drawbacks, and many papers have been published by members of the staff and others in the course of the year. These include valuable memoirs by Prof. Turner, Miss E. F. Bellamy, Miss M. A. Blagg (on Baxendell's "Variable Stars"), and Mr. R. J. Pocock.

MISS BOWEN COLTHURST has been appointed principal of the College of Agriculture, Holmes Chapel, Cheshire. The college is connected with the University of Manchester, and is fully equipped for thorough training in practical and scientific agriculture.

AN influential deputation of London members of Parliament and of the London County Council Education Committee and officials waited upon Mr. Fisher at the Board of Education on Tuesday to ask the Board for an increased grant for education purposes in London. In reply Mr. Fisher said he was prepared to recommend to the Treasury that an increased grant should be made. The grant would probably amount to something above 1,000,000*l*., but it would be given on the distinct understanding that the money should be used for education purposes only, and not for relief of present rates.

THE Elementary Education Sub-Committee of the London County Council has had under consideration the following resolution passed by the Central Consultative Committee of Headmasters:—"That the time is now ripe for the compulsory introduction of the metric system." The sub-committee is of the opinion that the time has now arrived when, in order to obviate the waste of time which is caused in the schools by the present system of weights and measures, and to facilitate commercial transactions, his Majesty's Government should be asked to make the metric system compulsory. The Education Committee of the council is in agreement with these views, and has recommended:—"That the council is of opinion that the time has arrived for the compulsory introduction of the metric system; that a communication to this effect be conveyed to his Majesty's Government; and that the council be recommended accordingly."

A BOOKLET describing the facilities for study provided by the various departments of the Imperial College of Science and Technology can be obtained on application to the secretary of the college. The guide was drawn up in the first instance specially for headmasters and science masters of schools and for colleges. It has been re-issued to provide persons anxious to have information as to the industrial careers for young men to which the Imperial College is specially directing its attention. The number of posts of an industrial character, in which high scientific education is of great importance, is constantly increasing throughout the Empire, and the Imperial College should after the war attract an ever-increasing number of students. We have also received separate parts of the calendar of the Imperial College, giving complete prospectuses of the associated colleges of the Imperial College, namely, the City and Guilds (Engineering) College, the Royal College of Science, and the Royal School of Mines.

IN August of last year the London County Council resolved that, subject to the establishment at the Imperial College of Science and Technology of a department of technical optics under a separate head; to the Government grant to the college being increased in respect of such department; and to certain other conditions, the council's grants to the college be increased in respect to technical optics by an amount proportionate to the increase in the Government grant as 1:3; provided that the increase in the council's equipment grant shall not exceed 750*l*., and that the increase in the council's maintenance grant shall not exceed 1000*l*. a year. The governing body of the Imperial College has now informed the council that it has adopted the recommendation of its Technical Optics Committee—which is also the Advisory Council for technical optics—that Mr. F. J. Cheshire be appointed director of the department of technical optics for a period of five years commencing June 1, 1917, at a salary of 1000*l*. a year. The Education Committee of the council, at a meeting held yesterday, recommended that this appointment be approved.

WE have received from the office of the *Field* and *Queen*, Breams Buildings, London, E.C.4, a copy of the English edition of "British Universities and the War: a Record and its Meaning," a little book compiled at the request of several correspondents in the United States who expressed the wish to have some permanent record of the response by the universities of the United Kingdom to the country's call for volunteers. The sixteen brief contributions by the vice-chancellors, principals, and masters representative of the various universities form an inspiring record of noble endeavour on the part of our university men; and to these unadorned statements of patriotic sacrifice and accomplishment Mr. Fisher, the President of the Board of Education, has contributed a gracefully appropriate preface. "No line," says Mr. Fisher, "can be drawn between student and teacher, between young and old. Many of the most brilliant teachers in the country have given their lives on the battlefield; many a bright star in the firmament of science has

been prematurely eclipsed." This generous estimate of the part men of science have taken in the war is noteworthy. "It has been a war of chemists, of engineers, of physicists, of doctors. The professor and lecturer, the research assistant, and the research student have suddenly become powerful assets to the nation. Whatever university you may choose to visit, you will find it to be the scene of delicate and recondite investigations, resulting here in a more deadly explosive, there in a stronger Army boot, or again in some improvement to the fast-advancing technique of aerial navigation." The brochure deserves to be widely read. Its price is 1s. net.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 10.—Sir J. J. Thomson, president, in the chair.—Sir Joseph **Larmor** and N. **Yamaga**: Permanent periodicity in sun-spots. A discussion of the more sharply marked phases of the curve of frequency of sun-spots, since 1750, led Newcomb, in 1901, to strong confirmation of the prevalent view, previously verified by Wolf and by Wolfer, that sun-spots are governed by some permanent periodic agency of period determined very closely by him as 11·13±0·02 years, and more recent independent discussions, by Wolfer in 1902 and by Schuster in 1906, have led them to conclusions nearly identical. The form of this periodic component is here extracted by semi-graphical methods, such as are appropriate to a permanent unbroken period, and also provide a further check on the degree of validity of the result. The periodic feature is found to be strongly and definitely present, provided the records for the two sun-spot cycles from about 1776 to 1798, which would largely vitiate it, are rejected as untrustworthy, or else are almost wholly assigned to some strong but transient anomaly. The residue of the sun-spot curve, when this periodic part is removed, seems to be accidental and sporadic, showing no other permanent periodicity of comparable period. The periodogram analysis of Schuster had, in fact, already led him to the result that the record is not homogeneously constituted even in the wider sense appropriate to natural radiation. The Fourier series here determined for the periodic part is found to be composed of sines only within the limits of attainable accuracy; thus the graph of that part is made up of anti-symmetrical undulations, a feature which may form a clue to its physical origin in the sun.—Prof. G. W. O. **Howe**: The high-frequency resistance of multiple-stranded insulated wire. The conductors employed in radio-telegraphy are frequently made up of a large number of fine wires separately insulated and stranded or plaited together in such a way that every wire occupies in turn the same relative position in the multiple conductor. In this way the total current is forced to distribute itself equally between all the wires, even at high frequencies. The object of this is twofold, viz. to make the inductance independent of frequency and to reduce the resistance at high frequencies. It is shown in this paper that the second object is rarely achieved because of the eddy currents induced in the wires by the magnetic flux within the conductor. It is shown also that the loss due to this cause is so great that the effective resistance of the stranded conductor is, in many cases, greater than that of the solid wire which could be put in its place. In the first part of the paper formulæ are deduced on the assumption that the eddy currents in the fine wires do not appreciably affect the distribution of magnetic flux within them. In the second part this assumption is not made and formulæ are deduced which take into account the screening effect of the eddy currents. It is proved, however, that the assumption is permissible in nearly all the cases considered. A number of tables are given showing the ratio of the high frequency to the continuous current resistances of straight and coiled conductors of different sizes made up of fine wires of three alternative diameters. These formulæ and tables enable one to see at once if any advantage is to be gained by using such a stranded conductor in any given case, and, if so, the best number of wires and space-factor to employ. The paper shows conclusively, however, that the extended use of such conductors in radio-telegraphy for the purpose of reducing the resistance has no scientific justification.

Physical Society, April 27.—Prof. C. V. Boys, president, in the chair.—Prof. J. A. **Fleming**: A note on the derivation of the general equation for wave motion in an elastic medium. The paper explains a simple method of arriving at the general differential equation for wave motion, viz.

$$\frac{d^2\phi}{dt^2}=c^2\left(\frac{d^2\phi}{dx^2}+\frac{d^2\phi}{dy^2}+\frac{d^2\phi}{dz^2}\right),$$

where c is the velocity of propagation of the wave. The method described may be epitomised by saying that the differential equation is obtained by equating the product of strain-acceleration $d^2\phi/dt^2$ and density to the static measure of the stress expressed as the space variation of the product of the elasticity and the strain slope $\left(e\frac{d\phi}{dr}\right)$, which is the proper measure of the stress at the point considered.—A. **Johnstone**: The effect of stretching on the thermal conductivity of wires. For all the wires used (copper, steel, nickel, aluminium, brass, zinc), stretching produced a slight increase in thermal conductivity. The most satisfactory experiments showed an increase of about 0·5 per cent for a tension of about 0·7 of the elastic limit. After the tension was withdrawn the conductivity returned approximately to its original value.—Prof. H. **Chatley**: Cohesion (third paper). The objects of the paper are:—(a) To re-state and add further evidence in favour of an electrical theory of cohesion. (b) To provide tentative empirical formulæ for the expression of intermolecular forces. The author defines cohesion as the net attraction (*i.e.* balance of attraction over repulsion) between molecules which are relatively chemically saturated, at distances not greatly exceeding the molecular diameters, and the following formula is proposed for this attraction:—$f_2=Gm^2/d^{(2+4d_0/d)}$, where G is the Newtonian constant of gravitation, m the molecular mass, d the molecular interval (centre to centre), and d_0 is the molecular diameter.

Royal Astronomical Society, May 11.—Major P. A. MacMahon, president, in the chair.—Dr. J. L. E. **Dreyer**: The origin of Ptolemy's Catalogue of Stars. For more than a century it had been the prevailing opinion that Ptolemy had borrowed all his star places from the catalogue of Hipparchus, merely adding a constant quantity to the longitudes to bring them up to his own epoch. It was contended that this opinion was ill-founded; that the catalogue of Hipparchus could not have contained more than 850 stars, so that Ptolemy could not have borrowed from Hipparchus the whole of his catalogue of 1025 stars. There appeared no reason for disbelieving Ptolemy's statement that he had himself made extensive observations of the fixed stars.—Dr. S. **Chapman**: (1) Convection and diffusion within giant stars. Prof. Eddington had shown that in a giant star of low density the temperature and pressure gradients towards the centre must be much less than formerly supposed, the influence of gravity being largely counteracted by radiation pres-

sure. An attempt is now made to determine the relative importance of convection and diffusion. Some of the heaviest elements appeared at high levels, not only in the sun, which is a dwarf star, but also in some of the giant stars. It is probable that convection extends to a considerable depth within the star, raising some of the heavier elements to the surface layer. (2) Thermal diffusion and the stars. It is found that the thermal effect is far outweighed by pressure diffusion, which tends to produce stratification into layers of increasingly heavy elements towards the centre. It is therefore probable that the presence of elements of widely different atomic weights in the solar atmosphere is mainly due to convection.—G. J. **Newbegin**: Solar prominences, 1916. Fewer observations than usual had been made, owing to the bad weather in January and December. The observations were plotted on a diagram, which was shown on the screen. A growth of activity all round the limb was indicated; even the polar regions were more filled up than in 1915, and the general brightness had increased. Dark absorption bands had been observed on thirty occasions.

Royal Meteorological Society, May 16.—Major H. G. Lyons, president, in the chair.—J. E. **Clark** and H. B. **Adames**: Report on the phenological observations for 1916. The year as a whole was rather warm, excessively wet, deficient in sunshine, and phenologically disastrous. This arose mainly from the peculiar distribution of wetness and warmth. January was dry in most parts, but February and March among the wettest on record, the precipitation largely as snow. February was colder than January, March than February, and in Ireland and England, S.W., April than January. Cold nights with frosts continued well into July, the former half of which and June were so disastrously cool that the mean was lower than in May, with a minimum of sunshine. Many days were cooler than many in January. The winter warmth developed abnormal premature growth, seriously damaged by the early spring-winter. The extreme wet of that time almost stopped farm and garden work; the cold nights later ruined much of the fruit crop, and the cold summer greatly lessened the quality of the harvest, being also largely responsible for the serious failure of the potato crop, combined with the most abnormal rainfall of the ripening-off and lifting time in late October and November. The tables largely reflect the above conditions, especially in the earliness of the hazel (two weeks), bringing it well into January (26th), perhaps for the first time; also the long range in date of the hazel, anemone, and blackthorn, averaging ninety-seven days compared with forty-six days for the late spring and early summer flowers, hawthorn, ox-eye, daisy, and dog-rose. This long range is due to colder districts giving dates after the cold spring break, and the earlier some records preceding it. A very important aspect has so far not been worked out, namely, the areas of equal date of appearance, which may be suitably denoted as isophainal zones. In Great Britain the earliest, before April 29, appears to include South-West Wales, Cornwall, Devon, a tongue stretching up from Hants to Worcestershire, East Sussex, Surrey, and Kent. All the rest south of the Mersey and Humber, except a large East Anglian area round the Wash, falls in the zone between 120 and 130 (May 9). The third zone to the 140 isophain covers the rest of England except Northumberland and Scotland bordering on the Solway. Northwards, dates later than May 19 prevail. In Ireland we get the 130 isophain from near Limerick to west of Dublin, and so on towards Newry, that of 140 passing from Clew Bay to Belfast Lough, with a southward bend round Lough Neagh.

PARIS.

Academy of Sciences, May 7.—M. d'Arsonval in the chair.—J. **Boussinesq**: The orientation of the principal pressures in the state of slip (by plane deformations) of a heavy sandy mass with a rectilinear upper profile.—General **Sebert**: Further observations concerning the possible influence of violent cannonades on the fall of rain. The Central Meteorological Bureau has continued to publish its bulletins throughout the war, but with a delay of one week. Observers on the connection between the weather and gun-fire should bear this fact in mind if they make use of the bulletins.—L. **Mangin**: *Chaetoceros criophilus*, a characteristic species of the Antarctic seas.—G. A. **Boulenger**: Batrachians connected with the genus Euproctus: their ethological and phylogenic relations.—M. **Balland**: Some experiments in bread-making in view of the continuation of the war. A study of the effects of mixing various proportions of barley, maize, rice, and other materials with wheaten flour for the preparation of bread. In case of necessity up to 10 per cent. to 15 per cent. of barley, oats, maize, rice, or manioc may be added to wheat flour, barley being preferable.—M. E. Fournier was elected a member of the section of geography and navigation, in succession to the late M. Guyou.—M. **Petrovitch**: Some remarkable numerical expressions.—B. **Jekhowsky**: The development in series of various algebraical expressions by means of Bessel's functions of several variables.—M. **Mesnager**: Solution of the problem of the thick rectangular plate, supported at its edges, and loaded with a single weight at its centre.—MM. **Fayet** and **Schaumasse**: Observations and provisional elements of the comet 1917*b* (Schaumasse). The observations were made on April 25, 26, and 27. On April 25 the comet appeared to be of 9·5 magnitude, showing a slight central condensation.—M. St. **Procopiu**: The concentration of electrolytes in the neighbourhood of the electrodes.—Ed. **Chauvenet**: The fluorides of zirconium and the zirconyl fluorides.—R. M. **Gabrié**: The commercial utilisation of fumaroles and hot springs. Calculations on the energy obtainable from steam jets issuing from the soil and from hot water of geysers.—J. de **Lapparent**: A Foraminifer from the chalk of the Alps and Pyrenees.—A. **Pezard**: Regression of the erectile organs, resulting from post-puberal castration in the Gallinaceæ.—Marie **Goldsmith**: The acquisition of a habit in the octopus.—E. **Kayser**: Contribution to the study of apiculate yeasts.—M. **Cazin**: Total heliotherapy in the treatment of men wounded in the war. An account of the results obtained by the sun treatment of wounded. Very favourable results have been obtained.—Ch. **Lambert**: A method of writing and reading easily accessible to the blind, and specially useful to blind persons who have lost the hands or forearms.—J. **Danysz**: Anti-luargol. Experiments are described proving that a preliminary injection of luargol provokes in the organism the formation of a precipitating antibody.—H. **Vincent**: The infection of wounds by the pyocyanic bacillus. Causes and treatment

SYDNEY.

Linnean Society of New South Wales, March 28.—Dr. H. G. Chapman, president, in the chair.—R. J. **Tillyard**: The morphology of the caudal gills of the larvæ of zygopterid dragon-flies Three main types of gills, according to the form of their cross-sections, are recognised—(*a*) the saccoid gill-type, presented by the Epallaginæ and the Protoneurinæ; (*b*) the Triquetro-quadrate type, occurring only in the Calopteryginæ; and (*c*) the lamellar type characteristic of the Lestidæ and most Agrionidæ. There is also a reduced (non-functional) type, of which the gills of *Agrion asteliae*, Perkins (Hawaii), furnish a good example. Onto-

genetic and phylogenetic questions will be discussed in a later paper.—Dr. J. M. **Petrie**: The occurrence of hydrocyanic acid in plants. Part iii. treats of five indigenous and seven cultivated cyanogenetic plants. Detailed experiments were made with a number of Alocasias, and a description of the distribution of the glucosides in the different parts of the plants is given. —Dr. J. M. **Petrie**: The chemical investigation of some poisonous plants in the N.O. Solanaceæ. Part iv., the chemistry of the Duboisias. This important group of endemic plants includes the pituri-tree of Central Australia and the cork-tree of New South Wales. The former is the only nicotine plant known other than the Nicotianas; and the latter contains the atropine-group of alkaloids, including the new nor-hyoscyamine. A third species, resembling the cork-tree, was also found to contain the same constituents. A complete historical account is given of the numerous chemical researches on the first two of these plants; and the contradictory evidence has been settled definitely by new experimental data. The proximate composition of the plants is compared and the investigation of their alkaloids described.

PETROGRAD.

Academy of Sciences, February 1.—E. S. **Fedorov**: A new descriptive geometry.—N. **Kulagin**: The ovary of the elephant.—V. V. **Zalenskij**: The segmentation of the ovum of *Salpa bicaudata*. First period.—E. **Busch**: Ericaceæ (Arctostaphylos, Arctous, Vaccinium, Calluna) of Siberia and the Far East.—A. M. **Nikol'skij**: *Coluber (Vipera) sachalinensis*, Czar., and its history. —G. J. **Vereščagin**: The basins in the vicinity of Lake Baikal.—Vl. N. **Šnitnikov**: The reptiles of the province of Semirěčje.—N. M. **Krylov**: Application of the method of W. Ritz to a system of differential equations.

HISTORICAL AND PHILOLOGICAL SECTION, January 25. —P. A. **Falev**: Account of an expedition in Transcaucasia and to Azerbeidžan in the summer of 1916.— N. Ja. **Marr**: (1) The Georgian epic, "The Hero in the Panther's Skin," by Šota of Rustav, and a new problem touching ancient Georgian culture. (2) A source of new information concerning the history of the Caucasian peoples.—I Ju. **Kračkovskij**: Description of the collection of Korans brought by F. I. Uspenskij from Trebizond.

BOOKS RECEIVED.

A Pocket Handbook of Minerals. By Prof. G. M. Butler. Second edition. Pp. ix+311. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

British Universities and the War: a Record and its Meaning. Pp. xv+88. (London: *Field* and *Queen*.) 1s. net.

Actions Physiologiques et Dangers des Courants Electriques. By J. Rodet. Pp. 87. (Paris: Gauthier-Villars.) 3.25 francs.

Differential Calculus. By Prof. H. B. Phillips. Pp. v+162. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5s. 6d. net.

Lessons in Pharmaceutical Latin and Prescription Writing and Interpretation. By H. C. Muldoon. Pp. vii+173. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6s. net.

Studies in Primitive Looms. By H. Ling Roth. (Halifax: Bankfield Museum.) 2s.

Staying the Plague. By N. Bishop Harman. Pp. viii+120. (London: Methuen and Co., Ltd.) 1s. net.

Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series C. Zoology and Botany. Vol. iv., part 1:—Mollusca. By C. Hedley. Pp. 80+9 plates. (Adelaide: R. E. E. Rogers.) 8s. 6d.

DIARY OF SOCIETIES.

THURSDAY, MAY 24.

ROYAL SOCIETY, at 4.30.—The Influence of Vibrations upon the Form of Certain Sponge-Spicules: Prof. A. Dendy and Prof. J. W. Nicholson.—The Lateral Vibrations of Bars of Variable Section: Prof. J. W. Nicholson.

ROYAL INSTITUTION, at 3.—The Chromosome Theory of Heredity and the Alternatives: Prof. W. Bateson.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Resources and Future of British Columbia: Dr. J. F. Unstead.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

AERONAUTICAL INSTITUTE, at 8.—The Testing of Materials for Aeronautical Construction: Edgar A. Allcut.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Shall Great Britain and America Adopt the Metric System?: W. R. Ingalls.

FRIDAY, MAY 25.

ROYAL INSTITUTION, at 5.30.—Breathlessness: J. Barcroft.

PHYSICAL SOCIETY, at 5.—An Investigation of Radium Luminous Compound: C. C. Paterson, J. W. T. Walsh, and W. F. Higgins.—The Resistance to the Motion of a Lamina, Cylinder, or Sphere in a Rarefied Gas: F. J. W. Whipple.—The Effect of Stretching on the Thermal and Electrical Conductivities of Wires: Dr. C. H. Lees.

SATURDAY, MAY 26.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

TUESDAY, MAY 29.

ROYAL INSTITUTION, at 3.—The Movement of Glaciers: Prof. W. W. Watts.

THURSDAY, MAY 31.

ROYAL INSTITUTION, at 3.—The Art of the Essayist: A. C. Benson.

FRIDAY, JUNE 1.

ROYAL INSTITUTION, at 5.30.—The Brontës; A Hundred Years After: J. H. Balfour Browne.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Post-Pliocene Non-Marine Mollusca of Ireland: A. S. Kennard and B. B. Woodward.

SATURDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

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THURSDAY, MAY 31, 1917.

NEW BOTANICAL HANDBOOKS.

(1) *Algae.* Vol. i., *Myxophyceae, Peridinieae, Bacillarieae, Chlorophyceae, together with a Brief Summary of the Occurrence and Distribution of Fresh-water Algae.* By Prof. G. S. West. (Cambridge Botanical Handbooks.) Pp. viii+475. (Cambridge: At the University Press, 1916.) Price 25*s.* net.

(2) *The Anthocyanin Pigments of Plants.* By Muriel Wheldale. Pp. x+318. (Cambridge: At the University Press, 1916.) Price 15*s.* net.

(3) *A Text-book of Botany for Colleges.* By Prof. W. F. Ganong. Pp. xi+401. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 8*s.* 6*d.* net.

(1) A SPECIAL interest attaches to Prof. G. S. West's volume on Algæ, as it is the first of a series of botanical handbooks which will be issued by the Cambridge University Press under the editorship of Prof. A. C. Seward and Mr. A. G. Tansley. The series has been designed to meet the need of books by specialists on different groups of the vegetable kingdom, and the present volume will be followed by others on Lichens, Fungi, and Gnetales, by Miss Lorrain Smith, Dr. Helen Gwynne-Vaughan, and the late Prof. W. H. H. Pearson respectively. Except for a faulty trimming of the pages (which, perhaps, is confined to review copies), the "get-up" of the book is excellent. An elegant cover, a clear text with numerous well-displayed figures, and a good index give promise of a series which, in the matter of production, should be admirable. The series opens well with the present volume, which is a biological account of the Algæ, both fresh-water and marine, included in the Myxophyceæ (or Cyanophyceæ), Peridinieæ, Bacillarieæ (Diatoms), and Chlorophyceæ (green Algæ). The greater part of the work deals with the green Algæ, a group to the investigation of which, especially the fresh-water forms, the author has devoted many years of thorough and painstaking research, and on the taxonomy of which he is one of the first authorities. The general structure, cytology, life-history, and biology of the various groups, of their subdivisions and more important genera, are described in considerable detail, and their classification and phylogeny discussed. Matters of controversy, such as the presence of a nucleus in the Myxophyceæ, or the mechanism of the movement of the Oscillatorieæ, are treated at some length with an impartial presentation of various opinions. As regards the nuclear question, the author decides in favour of its being an "incipient nucleus." There is also a valuable and expert discussion on the phylogeny and classification of the Chlorophyceæ, and the system adopted, which differs in detail from previous systems, is based on a critical review of the large amount of recent work and the wide experience of the author himself. The concluding chapter on the occurrence and distribution of fresh-water Algæ forms an introduction to their ecological study.

(2) It is not usual to begin a notice of a book with a reference to the bibliography, and it is in no sense disparaging to the value of the subject-matter of Miss Wheldale's account of the anthocyanin pigments of plants that we do so. But the admirable classified bibliography of 645 items, occupying seventy-six pages, indicates the wideness of the field and the variety of the points of view from which the study of the colouring matters in plants has been approached, from the investigations of Nehemiah Grew, towards the end of the seventeenth century, to the present day. It also supplies the motive for Miss Wheldale's book, which is a critical account of the various investigations which have been made upon the anthocyanin pigments along botanical, chemical, and genetical lines. The author is one of a number of recent workers who have raised the study of the colouring matters of plants from an empirical chemical examination of their nature and reactions, or somewhat hypothetical considerations of their biological meaning, to an important position in the study of inheritance. The development in plants of many and various anthocyanin pigments affords an almost unlimited supply of material for this study. "We have now, on the one hand, satisfactory methods for the isolation, analysis, and determination of the constitutional formulæ of these pigments. On the other hand, we have the Mendelian methods for determining the laws of their inheritance. By a combination of the two methods we are within reasonable distance of being able to express some of the phenomena of inheritance in terms of chemical composition and structure. There can be little doubt that exact information of this kind will be helpful for the true understanding of the vital and important subject of Heredity."

Miss Wheldale's work forms a text-book of an interesting and fertile branch of botany. The subject-matter is divided into two parts. Part i. is a "General Account," including an introductory chapter, or general survey, and chapters on the morphological and histological distribution of anthocyanins, their properties and reactions, isolation and constitution, the physiological conditions and factors influencing their formation, the reactions involved in their formation, and finally their biological and physiological significance. The second or special portion deals with anthocyanins and genetics.

(3) Prof. Ganong's published work on the teaching of botany is well known, and his apology for the issue of another text-book of botany is that his careful study of the psychology of the student has indicated that such a one is necessary. Introductory courses in botany are, he says, largely adapted to a preparation for a professional botanical career, whereas in the case of nearly all college students it forms part of a general education. "Knowledge is valuable to the specialist in the proportions of its objective importance, but to the general student in the proportions of its bearing on the actions and thoughts

P

of mankind." His book may be described as an attempt to present and interpret the humanly important aspects of plant nature in the light of our modern scientific knowledge, and the test of its value will be found, "not in whether my colleagues consider it a well-proportioned compendium of botanical fact, but in whether it leads students to pursue the subject in an interested and spontaneous spirit." Structure is treated before function, because that is the more practicable way, even though the reverse is more logical.

The present volume is Part i. of the whole work, and is entitled "The Structures and Functions of Plants." Part ii., "The Kinds and Relationships of Plants," containing the description of the groups of plants and comprising about 125 pages, is delayed, but is expected to be ready shortly. The subject-matter is divided into chapters which deal successively with the various organs, namely, leaves, stems, roots, flowers, fruits, and seeds. A summary of the treatment of the leaf will indicate the author's plan. The distinctive characteristics are first noted, the "green colour, flat form, and growth towards the light"; their function consists in the exposure of green tissue to light, under the action of which the plant forms its food out of water and mineral matters drawn from the soil and a gas received from the air. After a short account of general structure an experimental account of photosynthesis is given, which leads on to the study of the cellular anatomy and the characteristics of protoplasm and other cell-contents. Transpiration is then considered, and next the adjustments of green tissues to light. Various forms of foliage-leaves are described in association with various habitats, and in the following section the forms and functions of leaves other than foliage, such as leaves for storage, the insectivorous habit, climbing, bud-scales, and stipules. A section on the nutrition of plants which lack chlorophyll includes, besides phanerogamic parasites and saprophytes, a reference to the fungi. Sections on the autumnal and other coloration of leaves, and their economics and treatment in cultivation, are followed by a final section on the uses of photosynthetic food, which deals briefly with the various classes of substances found in the plant and their use to man. It is evident from this sketch that Prof. Ganong's treatment is somewhat unconventional. The text makes easy reading, and is facilitated by a large number of good figures; but there is sometimes a suggestion of scrappiness.

PHYSICAL CHEMISTRY.

Text-book of Thermochemistry and Thermodynamics. By Prof. Otto Sackur. Translated and revised by Dr. G. E. Gibson. Pp. xvi+439. (London: Macmillan and Co., Ltd., 1917.) Price 12s. net.

AT the present time, when considerable attention is being given to the industrial importance and value of chemistry, it is very necessary to emphasise the factors which not alone place chemical technology on a scientific basis, but are absolutely essential for real industrial progress. That much has been accomplished by more or less empirical methods is undoubted, and in certain cases, as a matter of fact, "theory" lags considerably behind "practice." This, however, is not an argument for relegating theoretical principles to the background. Empiricism, which is unavoidable when an industry is in an undeveloped state, is ultimately the greatest bar to further progress. Modern synthetic chemistry, in its widest sense, includes much more than the purely descriptive. The success of a chemical operation rests not only on whether the process can be carried out at all, but also on the careful elucidation of the best conditions under which to carry it out. The discovery of these conditions does not, or, rather, should not, be merely a matter of trial and error. The rational control of a process is determined by considerations of a wide and general nature applicable to processes of the most varied kind. To take an illustration. The problems of rapidity of working, of yield and efficiency, are intimately bound up with such general considerations as reaction-speed and its dependence upon concentration, temperature, pressure, and the catalytic effects of the surroundings, with the question of the equilibrium state as defined by the equilibrium constant, and the variation of this quantity with temperature and pressure. Problems such as these represent some of the technical applications of the principles of physical chemistry. To go no further, it is evident that the technical chemist must be acquainted with the principles of chemical kinetics and chemical thermodynamics, especially the latter.

In these circumstances a good text-book of chemical thermodynamics, such as the late Prof. Sackur's "Thermochemistry and Thermodynamics," is an asset not alone for chemical science, but equally so for chemical technology. The book itself is an exceedingly lucid exposition of the principles of thermodynamics, specially adapted for the needs of the chemist. In addition to covering the ground which we now regard as classical, it introduces us to those newer ideas which mark some of the more recent advances in physical chemistry. The problem of chemical affinity, which is all-important for chemical operations, is particularly well done. One is impressed by the essential unity of purpose underlying the most diverse considerations and fields of investigation. In the old days it would scarcely have been conceived that properties so very "physical" as specific heats and vapour pressures, for example, were ever likely to play any important part in determining the direction and extent of chemical change, but in the light of Nernst's heat theorem and the recent work on the quantum theory we are able to appreciate the truly chemical importance of these and other physical properties.

The experimental material with which Prof. Sackur illustrates the conclusions arrived at is ample and well chosen. Certain subjects, such as liquid mixtures and fractional distillation, the

thermodynamic significance of the mass-action equilibrium constant, Helmholtz's method of calculating the E.M.F. of a cell, the meaning of thermodynamic probability in relation to entropy, the laws of radiation, and many other problems, by no means simple in themselves, are here treated in an exceptionally clear and convincing manner. Prof. Sackur's book, regarded as a whole, is a demonstration of the truth of the words with which the introduction commences: "Everyone will admit that a thorough understanding of physical chemistry, and of the success of its applications in science and in technology, can only be obtained on the basis of thermodynamics."

It only remains to add that Dr. Gibson's translation is thoroughly satisfactory.

W. C. McC. Lewis.

OUR BOOKSHELF.

The Borderlands of Science. By Dr. A. T. Schofield. Pp. viii+255. (London: Cassell and Co., Ltd., 1917.) Price 6s. net.

Dr. Schofield tells us in the preface that his object in writing this book is "to present to the reader an entirely new outlook on the subject with which it deals. The word 'borderland' has hitherto been practically confined to a study of psychic phenomena; but here the meaning is so extended as to cover all that is obscure and unproved in any science." The world of concrete and abstract things is pictured as a huge disc, in the centre of which is God, "the first great cause (though Himself uncaused), dwelling in perfect light" (p. 3); and round the edge of the disc stand "the scientists" in a crowded circle studying the disc by feelers which each mind possesses and "by the light of their own reasoning powers" (p. 4). There are patches of the disc only half illuminated by either the human light or the Divine light, and these patches form the "twilight" regions—the borderlands of science (p. 6); and also there are patches "which we should know and need to know, but which science now clearly sees cannot be penetrated by its lights" (p. 7). "The goal of all human knowledge . . . is in touch with the Light itself, although to scientists at the circumference, who use only their own lights, it may appear to be impenetrable darkness" (p. 4). The Central Unity is also the God of revelation (p. 40); "as we leave the clear though limited light of science we become conscious of a vague premonition or prescience of the spirit world" (p. 63), and "there are some few districts of thought which are illumed neither by science nor by religion" (p. 62).

One would like to know how Dr. Schofield knows all this about the Central Unity. There seem to be some sensible and tolerant views on the borderlands of psychical science, and it is mostly the fundamental parts that seem self-contradictory. But there are also somewhat contradictory statements about the functions of science and philosophy (p. 10 and p. 12) and what makes up "mathematics" (p. 240 and p. 246). We read on pp. 33–34: "According to Myers, Socrates originated the idea of material sciences; but Swedenborg first attempted to introduce a science of the unseen, and his most illustrious follower in this particular direction has been Sir William Crookes."

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The Pruning-Manual. Being the Eighteenth Edition, Revised and Reset, of the *Pruning-Book,* which was first Published in 1898. By L. H. Bailey. Pp. xiii+407. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 8s. 6d. net.

This book deals with an important side of the care of fruit trees. The author considers that "the habit of growth, mode of flowering and fruit-bearing, and response to manipulation" may be grouped under the heading of pruning, and this wide view of the subject gives a special value and interest to the book.

In the earlier chapters the descriptions of the growth and branching of the more important fruit trees are remarkably clear, and should prove useful not only to fruit-growers, but also to teachers of botany and Nature-study. The later chapters deal with the general principles of pruning, and give directions for the treatment of the various fruit trees and ornamental shrubs grown in America. Prof. Bailey lays great stress on the necessity for the continuous good care of orchards as regards both pruning and tillage.

An interesting chapter on the care of street trees may be mentioned; instructions are given for the repairing and preservation of old trees which, on account of their position or association, may be specially valuable.

This manual is intended by the author to bring together the results of long experience in pruning "as handed down from gardener to gardener, fruit-grower to fruit-grower, and as recorded in many books." As early as the latter half of the sixteenth century the subject was dealt with by Heresbach in "Foure Bookes of Husbandrie" (1586), and also by Mascall (1575). The numerous references in this book, however, are chiefly to works published in the last twenty years, and especially to the reports of the valuable experimental trials which have been carried out at Woburn, at Wildpark (Germany), and in Utah, California, and Missouri. It is unfortunate that the author has not added a short bibliography, as the references are scattered in the text or in footnotes, and in one or two cases no date is given.

H. A.

The Aviator and the Weather Bureau. By Dr. Ford A. Carpenter. Second edition. Pp. 54. (San Diego: Chamber of Commerce, 1917.)

This small book gives a brief history of American aviation as it is associated with southern California, and contains a considerable number of interesting illustrations. It points out the advantage of the climate of California for aviation studies, and gives in chap. iii. an account of an ascent made by the author over the city of San Diego.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Plated Teeth of Sheep.

TWICE in recent years I have had brought to me by different people, as great curiosities, teeth of sheep or lambs, some of which were partly covered with a bright yellow metallic-looking film, which was thought to be gold. One of the persons referred to, as a foreign meat purveyor, had had a large experience with carcases of sheep, but had not observed the peculiarity before; and none of the farmers whom I questioned about the matter had ever seen or heard of it. But whether it is actually so rare a phenomenon as the above remarks suggest is doubtful, for the Rev. John Morton, in "The Natural History of Northamptonshire," published in 1712, p. 50, says:—

"Whether it be owing to some accidental uncommon Property in the Soil, that the Teeth of certain Sheep, and Cows, are tinged with a Golden, or rather Brazen Colour; whereof they have had instances in Staffordshire, as also here in this County, and of which I have now by me a pretty remarkable Sample that I met with at Oxenden; or whether it be owing to the feeding of Cattel upon yellow-flower'd Plants or to some other Cause, I shall not now stay to examine."

Actually, of course, the yellow film referred to consists of iron pyrites, and seems to require for its formation the concomitants of ferruginous matter, sulphates, and anaerobic bacterial action. Bacteria in the decomposing organic matter on or around the teeth may be supposed to reduce the sulphates with evolution of sulphuretted hydrogen, which latter reacts on the available iron to form the iron pyrites, FeS_2, a well-known chemical reaction commonly occurring in Nature under anaerobic conditions. It is consequently reasonable to suppose that the particular sheep, etc., exhibiting the characteristic spoken of, that of plated teeth, had been drinking water charged both with iron and sulphates.

Now most chalybeate waters are bog waters, where humic acids have first dissolved the iron, and then on oxidation deposited it in the form of the hydrated peroxide of iron, when sulphates may or may not have been present. But some chalybeate waters (including some bog waters), besides depositing iron, yield abundance of sulphates of iron, or calcium, or both; then obviously the original source of the iron was iron pyrites, probably marcasite. It would appear that this latter class of water would especially lead to the plating of the teeth of animals using it.

I should be rather glad to know of any instances where the result referred to could be actually traced direct to its cause.

BEEBY THOMPSON.

67 Victoria Road, Northampton, May 19.

J. E. B. Mayor and Todhunter.

THE review of Dr. MacFarlane's "Lectures on Ten British Mathematicans" in NATURE of May 17 closes with a quotation about Todhunter.

The words cited are attributed to Prof. Mayor, but a note of interrogation seems to imply some uncertainty as to which of the two brothers Mayor it was who wrote them. The quotation is from the late professor of Latin, *John* E. B. Mayor.

On the death of Todhunter Mayor wrote an "In Memoriam" notice of his old friend. It appeared in three consecutive numbers of the *Cambridge Review* for 1884. The first instalment appeared in the number for March 5. The quotation in NATURE is from the number for March 19, p. 262, col. 1.

Todhunter was not only a mathematician, but also a linguist. "Besides most European languages (including Russian, of which he learnt enough to master a mathematical treatise), he had studied Hebrew, Arabic, Persian, and Sanskrit. He was a sound Latin and Greek scholar" (*loc. cit.*, p. 229).

Unlike his great master, De Morgan, who is said to have been a skilful performer on both the organ and the tin whistle, Todhunter lacked the musical faculty. "He used to say he knew two tunes; one was 'God save the Queen,' the other wasn't. The former he recognised by the people standing up" (p. 261, footnote).

EDMUND SYMES PAYNE.

27 Constitution Hill, Clifton, May 21.

THE REMOULDING OF NATIONAL ADMINISTRATIVE INSTITUTIONS.

IN the recently issued third annual report (1916) of the Carnegie United Kingdom Trust, and fifteenth annual report (1915–16) of the Carnegie Trust for the Universities of Scotland, there is evidence of the deeply adverse influence which the heavy hand of war has exerted in directions usually the most remote from strife and rancour. The width of the influence is very evident, too, for these reports deal with subjects so diverse as higher education, scientific and literary research, music, church organs, libraries, etc. In the case of the former trust it is remarked that, "while the past year may confidently be said to have seen progress made with the work of the trust, the war and its reactions on the ordinary activities of the country have necessarily hampered any rapid development of schemes which are not directly concerned with its prosecution. A philanthropic trust is peculiarly subject to the difficulties of the moment, especially when its efforts must be entirely devoted towards the amelioration of normal conditions." In the case of the latter trust it is remarked that "the operations of the trust under the Research Scheme still continue to be considerably affected by the European war." Fellows and scholars of the trust "have been engaged on military duty," and some "are among the fallen." "The influence of the war . . . is seen in the diminished number of candidates for fellowships and scholarships, and still more in the fact that of those elected one half either did not avail themselves of the awards or resigned in the course of the session to engage in other work. It is also seen in the altered character of the research work of the beneficiaries, which, except in one or two cases, instead of following the usual lines, was directed to the solution of definite problems arising out of the war."

One can remember readily the time when applications were received by the universities from America, but never from the United Kingdom, for honours graduates to direct the labours of, *e.g.*, cotton manufacturers or gardening firms. That the war has made this old condition an impossibility for the future became forcefully clear in the recent report of the Advisory Council of

the Committee of the Privy Council for Scientific and Industrial Research. The report of the Universities Trust exhibits the effective response of the universities to recent calls. The report of the Council makes very evident the need, long recognised by scientific men, of change—drastic change—in the methods of industry, and the need for collaboration in endeavour. It makes also very evident the need for the theorist to direct and expedite the labours of the practical man; and, more satisfactory still, it shows that the practical man is now recognising it widely under the stress of war.

The future age is to be the age of specialisation and co-ordination. An interesting example of co-ordination appears in the reports of the Advisory Council and the United Kingdom Trust. The former body gave grants to the Stoke School of Pottery in order to aid "a threatened industry." The latter acquired the unique Solon Ceramic Library and presented it to the Stoke School in the hope that it might "help to strengthen the high standard of a national industry."

The specialisation and the co-ordination are to be directed towards the placing of national efforts on the fittest bases and in touch with the fittest methods. It is largely isolation and the lack of specialised scientific control in commercial and industrial endeavours that have led to the critical conditions upon which the war has focussed attention. The Committee of the Privy Council has already done much towards the removal of some of these conditions, and has proceeded tentatively to the inauguration of means to remedy widely the lack of co-ordination and the neglect of specialised control. The constitution of the machinery of the committee for the effective attainment of its national aims is very ideal. The committee itself includes the heads of the various governmental departments concerned, and its Advisory Council and very large Standing Committees are formed of *working scientific and technical experts*, whose decisions must obviously be determinative.

But there exist many pre-war administrations—boards, trusts, etc.—on a smaller scale, and many post-war administrations will arise also on a smaller scale, yet, nevertheless, dealing with matters of importance to the nation. In the case of the former there must be revision, in the case of the latter there must be supervision, in order that the fittest constitution may be framed and followed. In matters of business the framing should be moulded on business lines, and not, for example, on legal lines, though a slight admixture of legal opinion might be desirable. In matters of education the administrators should mainly be trained educationists, and not, for example, business men, though a slight proportion of these might be of advantage when the administration deals also with its own funds. In a mixed body it is not infrequently found that the best business member is one who never had a special business training; nevertheless, there are certain aspects of business which can be safely guided only by a trained specialist. On the other hand, it must also be recognised that the lines of success in a trading firm or a manufacturing firm are fundamentally different from those in an educational institution. Trade and ordinary business are of the nature of a war with tendencies, which may be, and often are, successfully combated, towards selfishness and hardness. And this tendency might easily develop into a national curse. In not very remote history a subordinate body, composed mainly of business men, intending to be well-intentioned, but misled by a mischief-maker and to some extent under the influence of the heritage of old feuds, worked behind the back of a superior body and almost involved both bodies in an utterly ruinous litigation. In that process they attacked, also behind his back and without his knowledge, a man whose life, in connection with the matter regarding which they attacked him, could easily challenge that of any one of them; for it had, in that very matter, been one of absolute innocence. Such a performance could scarcely be imagined in the case of a body of jurists, whose training begets sensitiveness to justice; or of a body of scientific men, whose training begets sensitiveness to accuracy and truth; or even of a body of literary men or artistic men, whose training confirms the sense of beauty.

In every case the scientific test of fitness must be applied. In pure business, the business man; in pure technics, the technical man; in technical science, the practical man and the man of science equally, or the latter preponderantly in cases of doubt; in education, the trained educationist, must have the determinative voice. So also in other matters. It is no less an important point that the specialists must be men *actively engaged* in the work which is their specialty. Under no other conditions can the fullest efficiency be attained. Nor can it be attained with certainty, unless these men are *in the majority* as regards either numbers or, at least, the weight effectively attached to their views.

When proved by these tests, of the three administrations here specially considered, only that of the Committee of the Privy Council seems to be of quite the fittest type. Although there is full internal evidence in the reports of the Carnegie Trusts that great weight is attached to expert advice, possibility should be changed into visible certainty. Nevertheless, one ought not to take cognisance of this condition without at the same time acknowledging, with full appreciation, the height of the aims of these trusts and the greatness of the results to which they have attained.

W. PEDDIE.

ANTISEPTICS, AND THE TREATMENT OF INFECTED WOUNDS.

FROM the beginning of the war the Medical Research Committee has paid special attention to the important subject of antiseptics in the treatment of wounds. The part taken by Sir Almroth Wright and the bacteriological depart-

ment of the committee is well known. At the same time the committee has supported independent inquiries in other directions, which fall under two main heads. The first group comprises the studies of the properties of hypochlorites and their derivatives. At Edinburgh Profs. Ritchie and Lorrain Smith produced and investigated the solution now widely known and used as "Eusol," in which the prefix is not Greek, as might be supposed, but stands for Edinburgh University. Simultaneously, Dr. Dakin, working in collaboration with Prof. Cohen, of the University of Leeds, and Dr. Carrel, in France, brought forward the now well-known "Dakin" hypochlorite solution, used widely for the French Army, for the British Army in France, and in America. Later, Dr. Dakin, working for the committee in its biochemical department, investigated the properties of paratoluene sulphochloramide, prepared earlier for him in Prof. Cohen's laboratory by a modification of Chattaway's original process. This antiseptic has already obtained wide use in England and France, under Dr. Dakin's name, "chloramine-T," and in America under the name "chlorazene." Being non-toxic and less unpleasant than hypochlorite solutions close to the nose, it has been specially useful in mouth and jaw cases, and from its property of ready adsorption by textiles, it provides antiseptic gauzes of far higher potency than those previously available.

The second group of inquiries supported by the committee has been concerned with benzene derivatives, and chiefly those already known to the synthetic dye industry. At a very early stage in the war, Surgeon-General Cheatle, with Drs. Fildes and Rajchman, investigated for the committee a series of compounds, of which they brought forward malachite green as having high value in the treatment of infected wounds. More recently, Dr. Carl Browning, working in the Bland-Sutton Institute of the Middlesex Hospital, who had previously worked with brilliant green and other synthetic dyes as weapons in the technique of bacteriological discrimination, has examined for the committee other synthetic dyes. Much interest has been taken in his statement of the antiseptic properties of what he proposes to call "flavine." This is an acridin derivative previously prepared and actually patented in Germany, to which Ehrlich gave the name "trypaflavin," on account of its trypanocidal properties.

Owing to the war, supplies of this substance were unobtainable, but Dr. Barger, in the biochemical department of the Medical Research Committee, prepared "trypaflavin" for the purposes of Dr. Browning's investigation, with the results already published. This, now called "flavine," Dr. Browning found to have, in addition to high bactericidal potency, the very remarkable, and at present wholly unexplained, property of gaining, instead of losing, in potency in the presence of serum, and it has the further valuable property of appearing to leave undamaged the activities of phagocytes in dilutions which still have high bactericidal power.

The committee has arranged for the manufacture of "flavine" upon a commercial scale for Government purposes, and as the new supplies become available it is hoped that complete clinical trials may be made of its value in the treatment of wounds. The preliminary reports already received from surgeons, based upon the first results of the laboratory manufacture, are most encouraging.

HOME-GROWN SUGAR.

THE announcement in the *Times* of April 19 that the Treasury has sanctioned a grant of 125,000*l.* by way of loan from the Development Fund towards the purchase of an estate for the purposes of sugar-beet growing and sugar manufacture marks an advance of the highest importance towards the establishment in this country of this valuable industry.

For many years an active propaganda directed towards this end has been carried on, and much valuable preliminary investigation has been completed. Numerous experiments in different parts of the country have shown conclusively that over wide areas sugar-beet crops fully equal in yield and quality to those of the Continent can be grown, and the ground has been effectively cleared for putting the possibilities of the industry to practical test.

For several reasons, however, previous efforts to establish the industry have met with but scant success. On one hand the uncertainty as to national policy in relation to the once vexed question of sugar bounties has been a potent inhibiting factor, whilst on the other the necessary establishment of sugar-beet growing areas round the factory to give an assured supply of beets has also presented the greatest difficulties.

Repeated efforts to obtain State assistance have encountered the obstacle that such assistance could be given only to enterprises from which the element of private profit was entirely eliminated. At long last, however, the efforts appear to be within sight of fruition, and with the more clearly realised need for the establishment of the industry and the closer consideration given to the solution of the difficulties involved, a scheme has been devised which Lord Selborne's committee in its interim report felt able to endorse as well thought out and sound.

This enterprise for which Treasury support has been obtained is to be carried out by the British Sugar-Beet Growers' Society, Ltd., an organisation not trading for profit, and created specifically for the purposes of the scheme, with Capt. Beville Stanier, M.P., as chairman, and an influential and representative committee, with expert advisory assistance. Through the vice-chairman, Mr. E. Jardine, M.P., an estate of 5600 acres has been acquired at Kelham, near Newark, where it is proposed to grow a large area of sugar-beet and to erect a factory for its manufacture into sugar. The estate is very favourably situated for both rail and canal

transport, and would appear to be well adapted in every way for the purpose.

The enterprise, when fully developed, is estimated to cost 500,000*l.*, but, for obvious reasons, only a very limited development is possible at present. With the large acreage at its disposal, some of the difficulties which have beset earlier enterprises are obviously greatly reduced. The scheme also presents other features which inspire confidence in its ultimate success, and the progress of this important national experiment will be watched on all sides with the greatest interest. C. C.

SIR A. R. BINNIE.

A GREAT engineer, Sir Alexander Richardson Binnie, born in London in 1839, died on May 18 at the age of seventy-eight. He joined the Institution of Civil Engineers in 1865, and in 1905 became its president. He was a member of the Institution of Mechanical Engineers, the Geological Society, and other societies, and contributed to their Transactions several valuable papers. Always interested in historical studies, he sketched in an address to the Institution of Civil Engineers the progress of science and engineering during the eighteenth and nineteenth centuries.

Sir Alexander served a pupilage to Mr. T. W. Flanagan and John F. La Trobe Bateman, and was at first engaged on railway construction in Wales. After a short period of practice in London he went in 1868 to India, and as executive engineer in the Department of Public Works was engaged in coal exploration, on railways, and in carrying out schemes of water-supply. His most important work in India was the construction of a reservoir for the supply of the city of Nagpur. In 1875, when in England on furlough, he was consulted by the Bradford Corporation with regard to difficulties which had arisen in the water-supply of that city. He became the water engineer of Bradford, a position he retained for fifteen years. From 1890 to 1901 he was the chief engineer to the London County Council, and greatly assisted in the reforming activities of that time. He completed the sewage works at Barking and Crossness, and directed the construction of the Blackwall Tunnel, the Barking Road Bridge, and the Highgate Archway. In 1897 he was knighted. During this period he studied a scheme for the supply of water to London from North Wales. He surveyed a watershed in the valleys of the Wye and Usk capable of discharging 415 million gallons daily after allowing for losses. The water was to be brought to London by two conduits, 150 to 170 miles in length. The scheme was very carefully worked out, but its cost was deemed prohibitive, and London was content with a supply from less pure sources nearer at hand.

When in India Sir Alexander investigated questions of rainfall, evaporation, and flow off the ground, as to which for tropical countries there was not much information at that time. He was specially interested in tracing a connection between sun-spot periods and the fluctuations of rainfall.

Sir Alexander had great kindliness and courtesy and was greatly respected by all who knew him. He was an excellent witness before Parliamentary Committees and in the law courts, where his great knowledge, clear statement of his case, and obvious honesty gave weight to his evidence.

NOTES.

The memory of the late Prof. Raphael Meldola is cherished with affection by workers in many scientific fields. It is to be hoped that a worthy memorial will eventually be established as a national tribute to his work and influence, but it is thought that the present is not an appropriate time for a public appeal with this object in view. Moved, however, by a desire to preserve a permanent impression of his features, some of Meldola's friends are arranging to present his portrait to the Royal Society and to the Institute of Chemistry, and subscriptions varying from half a guinea to ten pounds have already been contributed by those who have heard of this intention. There are doubtless others who will welcome the opportunity of taking part in this modest expression of esteem, for Meldola was known to students of widely different branches of science, and it is feared that some of them may have been overlooked when the invitation to subscribe to the memorial was sent out. We are glad to assist in repairing any such inadvertent omission by directing attention to the Meldola Portrait Fund, for which an account has been opened at Messrs. Barclay and Co.'s Bank, Oxford, Banbury Road Branch. In these columns it is unnecessary to dwell upon Meldola's scientific achievements, the breadth of his intellectual sympathy, or the patriotic zeal with which he wore himself out in his country's service—his friends knew these qualities fully, and it is they who wish to show appreciation of them by the presentation of his portrait to the two societies mentioned, both of which will gladly welcome this memorial of him. Mr. Solomon J. Solomon, R.A., has consented to paint the portraits, and has entered into the scheme in a most generous spirit. Contributions for the fund should be sent to Prof. E. B. Poulton, Wykeham House, Oxford.

Dr. Jørgen Brunchorst, Norwegian Minister in Rome, who died in that city on May 20, was in his early days a botanist. Born at Bergen on August 10, 1862, he was assistant to the professor of botany at Tübingen, and took the degree of Ph.D. at Heidelberg in 1885. He studied chiefly the physiology and diseases of roots, and published several papers on those subjects from 1884 to 1888. Appointed conservator of Bergen Museum in 1886, he soon took part in communal life by publishing a practical book on the diseases of the economic plants of Norway (1887). The age of D. C. Danielssen threw much administrative work on Brunchorst, who was first the museum's secretary, and succeeded to the post of director in 1901. It was he who took the lead in all public lectures to students and to the public, the editing of the popular periodical *Naturen*, the planning of the Botanic Garden, and the establishment of the Biological Station. Further than this, he strongly supported co-operation with the other northern nations and with this country in the fisheries investigation of

the North Sea. He was delegate to the Fishery Congress at Dieppe, and to the second conference on the International Catalogue of Scientific Literature held in London in 1898. Virile and straightforward in manner, of keen intelligence and wide sympathies, Brunchorst will be much regretted by those friends in this country from whom he has been taken at an age so unexpectedly early.

ENGINEER REAR-ADMIRAL G. G. GOODWIN, C.B., has been appointed Engineer-in-Chief of H.M. Fleet, with the rank of Engineer Vice-Admiral, in succession to Engineer Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S.

DR. C. D. WALCOTT, secretary of the Smithsonian Institution, has been elected president of the U.S. National Academy of Sciences, in succession to Prof. W. H. Welch, of the Johns Hopkins University; and Dr. A. A. Michelson, of the University of Chicago, has been elected to succeed him as secretary of the academy.

THE annual meeting of the Institution of Gas Engineers is to be held on Tuesday, June 5, at the Institution of Civil Engineers, when reports will be presented of the research committees on, respectively, Refractory Materials, Gas Lighting, Heating and Ventilation, and Life of Gas Meters. Lord Moulton, F.R.S., has been nominated for election as president of the institution for the year 1917–18.

AT the monthly general meeting of the Zoological Society of London, held on May 16, his Grace the Duke of Bedford in the chair, it was announced that, in comparison with the corresponding period in 1916, there was a decrease in the number of visitors of 75,353, and a decrease in the receipts of 1756*l*. The additions to the society's collections during the month amounted to 130, of which special mention may be made of a female chimpanzee from West Africa, two pandas (*Aelurus fulgens*) from Nepal, and a Demidoff's galago (*Hemigalago demidoffi*) from Ashanti.

WHILE we are glad to know that it has been decided to establish a National War Museum, we are not a little alarmed at the many impracticable and sometimes fatuous suggestions as to the nature of the objects which should find a place there. We do not, for example, consider that ornaments made of chewed bread, even though they were made by prisoners of war in internment camps, are worthy of a permanent place in such a collection. As well might we add a lump of mud from the wheel of a limber in Flanders! The writer of a long article on this theme in the *Museums Journal* for May expresses a hope that the Tower of London may be used as the repository of this collection, and there are even people who seem to agree with him. But if a tithe of the things he proposes to admit are collected, an annexe several times the size of the Tower will have to be provided. By all means let us have this museum, but let a little judgment be exercised in its formation.

IT is announced from New York by the Exchange Telegraph Co. that the members of the Crocker Land Expedition are safe at Etah. The expedition sailed for the Arctic in July, 1913, under the auspices of the American Museum of Natural History of New York, to explore the land supposed to lie north-west of the line of islands stretching from Grant Land to Prince Patrick Land. Two years later, however, Mr. Donald B. Macmillan, the leader, sent a message which, after recording several misadventures which the expedition had encountered, announced that Crocker Land did not exist. He and his companions have since remained in the Arctic, mapping uncharted coast lines and carrying on other scientific work.

THE fifteenth annual session of the South African Association for the Advancement of Science will be held at Stellenbosch, from Monday, July 2, to Saturday, July 7, inclusive, under the presidency of Prof. J. Orr. The sectional committees and their presidents will be as follows:—A: Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation, Prof. W. N. Roseveare; B: Chemistry, Geology, Metallurgy, Mineralogy, and Geography, Prof. M. M. Rindl; C: Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene, and Sanitary Science, J. Burtt-Davy; D: Education, History, Mental Science, Political Economy, General Sociology, and Statistics, Rev. Prof. N. J. Brümmer; E: Anthropology, Ethnology, Native Education, Philology, and Native Sociology, Rev. N. Roberts. The local secretary is Prof. B. van der Riet, Victoria College, Stellenbosch.

THERE lately passed away a notable public servant in the person of Mr. Alexander Gibson, late Senior Chief Cartographer at the Admiralty. The public hears much of some of its prominent officials, but is unaware of the existence of many highly technical services that are silently rendered to the State, without public recognition, and sometimes without much official encouragement. Mr. Gibson was, however, well known in that circle of scientific interests concerned with geographical and cartographical work, and had been a distinguished occupant of the official position referred to, from which he retired in 1914, after forty years' service at the Admiralty. When the war commenced he was recalled to continue his services, and was at work until a few days before his death. Mr. Gibson's long and continuous service at the Admiralty had made him an unequalled authority upon the charts of the coasts and waters of the world, both British and foreign, and with his great capabilities for critical examination and research he contributed many important records of high value to the work of accurate chart construction.

DR. GEORGE SARTON will be known to many readers of NATURE as the editor of the excellent quarterly, *Isis*, which was published near Ghent until the war stopped publication. Dr. Sarton is at present lecturing at Harvard University, and is continuing with his usual vigour his important work in organising the history and use of science in civilisation. In *Science* for March 23 last he published a very interesting proposal for an American Institute for the history of science and civilisation, which appeals "to those interested in placing before American students advantages not only greater than are now offered in this country (America), but greater than those offered abroad." "Science," says Dr. Sarton, "is the strongest force that makes for the unity of our civilisation, and it is also essentially a cumulative process, and hence no history of civilisation can be tolerably true and complete in which the development of science is not given a considerable place." Particularly interesting among the activities of the proposed institute is that of publishing two journals, one of a popular nature, and the other of the highest scientific character. The scientific journal might be a series of editions of important scientific manuscripts, or a journal of the type of *Isis*, which should record the world's work on the subject. It may be added that perhaps this scheme might fit in with the admirable suggestion made by Prof. Rignano in NATURE of January 25 last of a quadruple scientific "Entente." Now America has jointed the Entente, our scientific future is certainly rosier. Dr. Sarton's note concludes with an imposing list of American men of science who are in sympathy with his project.

AT the May meeting of the Society of Glass Technology Prof. Herbert Jackson gave a short account

of the valuable work accomplished in glass research since 1914 at the instigation of the Institute of Chemistry and the Ministry of Munitions. One outcome of this work has been the placing of at least fifty new batch formulæ at the disposal of glass manufacturers, to experiment with, to adopt, and to improve. Amongst the most important formulæ available may be mentioned batches for resistant and ordinary chemical ware; soft glass for lamp work; combustion tubing; various types of glasses for X-ray work; opal glasses; thermometer glasses; and optical glasses. To show the widespread nature of the researches already carried out upon glass, he said, the effect of almost every known element has been tried, and many glasses with interesting properties are now available both for present and post-war use. By fostering research in many directions and by the admission of science in its most advanced form into their industry glass manufacturers have ensured the progress of the industry in the future. The enthusiasm of the manufacturer is reflected in the founding of the Society of Glass Technology, and the interests of the whole glass industry are being well served by the glass technology department of the University of Sheffield, and by the numerous representative committees set up by the Ministry of Munitions. The glass industry, in fact, is a striking example of the co-ordination of the manufacturer and man of science at its best. The next meeting of the Society of Glass Technology will be in June, at the University of Sheffield, when a joint discussion on refractory materials has been arranged with the Faraday Society.

IN the May issue of *Man* Mr. E. W. P. Chinnery describes the use among the coast tribes of Papua of the conch shell and wooden trumpet as a mode of signalling. This is usually performed by males, but women sometimes use these instruments, and in the Kikori River delta women beat a kind of tattoo with sticks on the sides of their canoes to announce the killing of men and pigs, while the males sound calls on the conch shell. This account is supplemented by a note contributed by Dr. A. C. Haddon, with a good bibliography, in which he describes the distribution of similar wooden trumpets in Netherlands New Guinea and on the Sepik River.

IN the Transactions of the Glasgow Archæological Society, N.S. (vol. vii., part i.), Sir P. I. Hamilton Grierson discusses the question of fosterage, not as a chronicle of phenomena, but as a process of evolution. By fosterage he means the rearing of a child, undertaken at the request of its parents by someone who is neither its father nor its mother, for a limited time, with the result that a bond is created between the foster-child and its foster-parent and foster-brethren, and, in many instances at any rate, between the natural father and the foster-father. Dealing with the question in detail from this point of view, he arrives at the conclusion that if we would make fosterage yield the secret of its origin, we must study it in connection with other forms of artificial relationship—the milk-bond, the bond of the blood-brothers, the bond of adoption, the bond of gossiprede, and the bond existing between teacher and scholar; and such a study will be found to illuminate not only the questions involved in this inquiry, but other vexed problems of early family relationships.

IN a pamphlet published for the Polish Information Committee, Mr. W. Nalkowski has endeavoured to show what the natural features of Poland are which give it its individuality ("Poland as a Geographical Entity." London: Geo. Allen and Unwin, Ltd., 6d. net). Despite considerable compression and a rather ponderous style, the author has succeeded in giving a very able and useful survey of the characteristics of Polish geography, and has proved his contention that the outstanding feature is the "transitionality" of Poland. It is a country in which western and eastern Europe mingle, and the reciprocal action of these influences gives a colour to its life. Whether or not that characteristic is one which fits Poland to stand as a separate nation might be open to argument. Mr. Nalkowski foresees this criticism, which he answers by pointing out that original Poland has clear frontiers to north and south, and in the basin of the Vistula has a nucleus around which the country centres. The latter contention, to a certain extent, is true, but the transitionality of Poland results not from her northern and southern frontiers, but from her eastern and western ones, which the author admits are weak. These indefensible frontiers have subjected Poland to heavy blows and ceaseless struggles in the past. The future of a regenerated Poland will show whether open frontiers favouring human intercourse stand a country in better stead than physical barriers crossed with difficulty. The pamphlet is a useful contribution of geography to a problem in world-politics and throws much light on the subject.

THE annual report for 1915 of the Technological Museums, Sydney, New South Wales, well indicates the way in which our Colonies are using the collections in their great museums. We learn, for example, that "it is clear to most people now that the prosperity and safety of the Empire will in a large measure depend upon the manner in which scientific research and discovery are encouraged in the future. If we are to succeed, no initial outlay should be spared, as it does not take long, once a discovery has been made into a going concern, for the initial outlay to be easily covered. This is well illustrated in one of the museum researches alone—*i.e.* on the pines of Australia—as the commercial advantages to the State will more than repay a hundredfold the cost of the whole of the researches carried out here. Consequently, I view with great interest the proposal of the Prime Minister to establish a Bureau of Scientific Research—a scheme which, if carried out on proper lines, will no doubt result in an effective achievement worthy of Australia." The present report deals with the technological work of the Technical Education Branch of the Department of Public Instruction, and the document is illustrated by reproductions of photographs of the "Australian Essential Oil Cases" and the "Museum Essential Oil Still." Mr. R. T. Baker is the curator.

THE life-history of bacteria is dealt with by Mr. Edward Hort in a paper in the *British Medical Journal* (May 5, p. 571). The current view is that bacteria reproduce by simple binary fission and occasionally also by endospore formation. Mr. Hort maintains that a relatively complicated life-cycle takes place in the enteric group of bacilli which he has studied. Superficial, median, and terminal minute buds are formed by gemmation from the parent, and these buds may undergo segmentation. The buds vary in size from about 0·1 μ to several μ, and the smallest forms may be filterable. Some of the aberrant forms in cultures may be mutations or developmental stages, and not involution forms as they are usually regarded. In order to demonstrate the various stages a somewhat acid broth was used as culture medium, and the films were treated by Benian's Congo-red absorption method for microscopical examination.

MR. N. L. BOWEN adds an important paper to his previous study of nepheline, and has prepared the potassium representative of this mineral artificially (*Amer. Journ. Science*, vol. xliii., p. 115, 1917). This

artificial kaliophilite is occasionally accompanied by leucite. An orthorhombic form of $KAlSiO_4$ has also arisen during the experiments. Readers of this paper may like to note Dr. A. Scott's references to artificial nepheline and carnegieite prepared by him (Trans. Geol. Soc. Glasgow, vol. xvi., p. 41, 1916).

MR. E. T. WHERRY (*American Mineralogist*, vol. i., p. 37, 1916) shows that crystals of glauberite, $Na_2Ca(SO_4)_2$, were deposited during the drying of fluviatile beds of Triassic age in eastern Pennsylvania, in place of those of rock-salt that are familiar in many areas. The author attributes this occurrence to the composition of the local waters; it seems possible that glauberite, which has a low solubility, represents a stage antecedent to that of the deposition of gypsum, and that the continued trickle of waters seaward carried off the sodium chloride and many other salts.

A PROCESS is described in the *Scientific American* for April 21 for coating the end portions of wooden propeller blades for aeroplanes, etc., with a thin layer of copper, by which they are strengthened, given a better cutting edge and surface, and protected from brush, etc., on landing. The details of the process are interesting. First, the wood is rendered impervious by saturating with a wax varnish, which is then coated with a thick linseed-oil varnish. Then a shellac varnish is applied and allowed to dry. A thin deposit of silver sulphide is produced by treatment with a silver nitrate solution made with alcohol and water, the surface being then exposed to sulphuretted hydrogen gas. Copper is electrolytically deposited on this film.

THE Ordnance Survey has published, at the price of 3s., a geological map of Dublin on the scale of 6 in. to 1 mile. The topographic basis is identical with sheet 18 of the Ordnance Survey map of the county of Dublin. The map embraces the city, Phœnix Park, and a large outlying residential district. The superficial deposits, boulder clay, glacial gravels, river gravels, alluvium, and materials on the area in-taken from the sea, together with the few patches of underlying limestone rock which rise to the surface, are indicated by separate colours. The alterations, due partly to human, partly to marine agency, in the coastline at the west end of Dublin Bay are well shown by the insertion, in red dotted lines, of the coast as represented in a map by Bernard de Gomme, published in 1673. We believe this is the first urban district for which a cheap colour-printed map has been published on the six-inch scale. This excellent example might well be followed in the case of each of our larger town areas. Such maps, particularly if they were accompanied by a short, clear, explanatory pamphlet, would be invaluable for educational purposes, and copies should be hung in every urban school. They would also be of very great use to architects, surveyors, and engineers, and to all who are concerned with house-sites or town planning.

AN effort is being made by the American National Advisory Committee for Aeronautics to promote the study of the atmosphere over the United States and the adjacent seas, and have a set of accurate charts made for the benefit of aviators. We wish the committee every success in the endeavour, but there is a proverb "as uncertain as the wind," and it is difficult to see how so uncertain an element as the wind can be charted at all, much less "accurately charted." No doubt the Weather Bureau has a large amount of information as to the strength and direction of the prevailing winds, and in America, as in Europe, the wind at a few thousand feet height will in general agree more or less with the isobaric charts, but a knowledge of the prevailing wind will not much increase the safety of an aviator who has to fly at a definite time and place. It is a correct and definite forecast rather than a chart that he requires, and it has been, as a matter of course, the chief object of the U.S. Weather Bureau to be able to give such forecasts for many years past. Extending the forecast to some 5000 ft. altitude is a comparatively easy matter when the surface conditions can be accurately foretold.

SOME interesting results of a spectroscopic investigation of sources of ultra-violet radiation for therapeutic purposes are given by C. A. Schunck in the Journal of the Röntgen Society for April. Among the sources examined were electrodes of pure metallic tungsten, molybdenum, and iron; carbon rods impregnated by boiling in solutions of sodium tungstate, uranium nitrate, and ammonium molybdenate; cored carbons filled with uranium oxide or wolfram; and the Simpson electrodes, which are said to consist of wolfram. The most intense source of ultra-violet radiations was found to be the electric arc with metallic tungsten electrodes, the spectrum being so full of lines as to be almost continuous to the limit of the spectrograph employed, at λ 2130. The Simpson arc gives a very similar spectrum, but the unsteadiness of this source is a disadvantage. The impregnated carbons give much more intense radiation in the spark than in the arc, a mixture of uranium nitrate and ammonium molybdate being the richest in ultra-violet radiations of any spark source. Observations of the effects of the various sources appear to show that the radiations of greatest therapeutic value lie between λ 3000 and λ 1850, and further spectroscopic observations to ascertain which part of this region has the greatest efficiency are in progress. The paper is illustrated by an excellent series of photographs of spectra.

IN part 5 of vol. v. of the Science Reports of the University of Sendai, Japan, Prof. K. Honda and Mr. J. Ôkubo apply the theory of ferro- and para-magnetism, published three years ago by Prof. Honda, to the effect of temperature on the magnetism of ferro-magnetic substances, and find a close agreement between their deductions from the theory and the experimental facts. According to Prof. Honda's theory, the molecules of a ferro-magnetic substance are nearly spherical, and the impacts of the molecules on each other due to their thermal motions have only a small effect in rotating the molecules, while the effect of their mutual magnetic action on each other is considerable. The molecule of a para-magnetic substance has, on the contrary, a more or less elongated form, and thermal motions have in consequence a great effect on the molecular rotations. The effect of the rotations in the case of the ferro-magnetic material is worked out in detail for weak external fields in the present paper, and it is shown that the magnetisation will diminish as the rotation increases, at first slowly, then faster, and that at a given angle the magnetisation will disappear. The effect of temperature on the permeability of ferro-magnetic substances is also investigated, and the curves connecting permeability with the angle of rotation are shown to be of the type found by Hopkinson for the relation between permeability and temperature in weak fields.

IN the Bulletin of the Société d'Encouragement pour l'Industrie Nationale for March–April M. Paul Janet gives some interesting details of the foundation and activities of the Laboratoire Central d'Electricité at Paris, which is administered by the Société Internationale des Electriciens under an arrangement

with the State. The work of the institution is divided broadly into (1) tests and standardisation work for the public, (2) researches. The tests, etc., cover the checking of all kinds of electrical instruments. Among these may be mentioned the tests undertaken for the Marine Ministry on new types of storage battery for use in submarines, and standard tests on electric lamps used in the Navy. Investigations have been made for the War Ministry on meters, etc., used in gunpowder factories, also check tests on standard meters used by the Army in its own specification tests. The laboratory undertakes for the Ministry of Public Instruction and Fine Arts. the verification of lightning arrester installations on public buildings. On the research side may be mentioned the important researches published by M. Ch. David on the various grades of carbons used for dynamo brushes; M. Jouaust's researches on the magnetic properties of iron, its magnetic viscosity, and its permeability at high frequencies; and MM. Laporte and de la Gorce's researches on the dielectric strength of insulating materials under continuous and alternating tensions and at varying frequencies. In 1914 the laboratory had in hand researches (which will be continued) on the Violle platinum light standard. MM. Broca and Laporte have undertaken experiments on the action on the human eye of various artificial sources of light, while Dr. Weiss and M. David have studied the mechanism of death from high-tension alternating currents. The Laboratoire Central represented France at the international experimental work carried out at Washington in 1910, as the result of the International Conference on Electrical Units and Standards held in London in 1908, and has published papers on the subject.

MR. A. CHASTON CHAPMAN's lecture on "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," delivered before the Chemical Society in March, has been reproduced in the Journal (vol. iii., pp. 203–20). Attention is directed to the increasing use of physico-chemical methods, the spectroscope and polarimeter being now supplemented by the refractometer, the electrometer, and a wide range of electrochemical apparatus. In the same way the use of derivatives of hydrazine as qualitative and quantitative reagents in organic chemistry has been extended by using phloroglucinol to precipitate furfural in estimating pentoses and pentosans, of digitonin to estimate cholesterol, and of picric and picrolonic acids in identifying such bases as arginine, histidine, lysine, and guanidine. Organic compounds have also been introduced as reagents in inorganic chemistry, notably in the colorimetric estimation of nitrates and nitrites. Actual precipitation occurs, however, when benzidine hydrochloride is used to precipitate sulphates, or "nitron" to precipitate nitrates, the latter reagent furnishing for the first time a method for the gravimetric estimation of nitric acid. The separation of nickel from cobalt by means of dimethylglyoxime is characteristic of a considerable group of separations which can now be effected with remarkable ease and efficiency by making use of complex organic compounds. Biological processes, such as the selective fermentation of sugars by different species of yeasts, and the use of the "precipitin" reaction to distinguish between albumins from different sources, have also proved of great value in the analysis of foodstuffs. In conclusion, the lecturer urges the desirability of providing in this country professorships of analytical chemistry, similar to those which exist already on the Continent and in America.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued a catalogue (New Series, No. 79, "Books and Papers on Microscopical Science in all its Branches") which should be of interest to many of our readers. It is conveniently arranged under the headings:—Bacteriology, Parasitology, etc., Diatoms, Entomostraca, Foraminifera, Fresh-water Algæ and Desmids, Infusoria, Micro-Entomology, Micro-Fungi, Petrography, Crystallography, etc., Protozoa, Rotifera, Zoophytes, Biology, Histology, Physiology, and General Works on the Microscope. Many of the works catalogued, being published in enemy countries, are difficult to obtain at the present time. The list is to be had upon written application.

THE following works are in preparation for appearance in the "Cambridge Public Health Series" (*Cambridge University Press*):—"Ticks as Carriers of Disease," Prof. G. H. F. Nuttall; "Serum Diagnoses," Dr. C. Browning; "The Purification of Water in Sedimentation, Filtration, and Precipitation," Dr. A. C. Houston; "The Purification of Water by Ozone and Chlorine; and Domestic Filters," Prof. G. Sims Woodhead; "The Principles and Practice of the Dilution Method of Sewage Disposal," Dr. W. E. Adeney; "Disinfection," Dr. C. W. Ponder; "Housing in Relation to Public Health," Dr. C. J. Coleman; "School Hygiene," Dr. E. T. Roberts; "Soils, Subsoils, and Climate in Relation to Health," G. Walker; "Meat Inspection," Dr. W. J. Howarth and T. D. Young; "Vital Statistics," R. Dudfield and G. U. Yule; and "Foods, Sound and Unsound," Dr. H. C. Haslam.

OUR ASTRONOMICAL COLUMN.

COMET 1917*b* (SCHAUMASSE).—From observations of this comet made on April 28, April 29, and May 4, the following elements and ephemeris for Greenwich midnight have been calculated by J. Braae and J. Fischer-Petersen:—

$$T = 1917 \text{ May } 18{\cdot}2946 \text{ G.M.T.}$$

$$\left.\begin{aligned} \omega &= 119^\circ\ 11'{\cdot}90 \\ \Omega &= 9^\circ\ 37'{\cdot}25 \\ i &= 158^\circ\ 42'{\cdot}87 \end{aligned}\right\} 1917$$

$$\log q = 9{\cdot}88304$$

1917		R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ
May 31	...	8 25 32	+38 30·2		9·7109
June 1	...	8 35 14	36 2·7	9·9101	9·7375
2	...	8 43 12	33 50·2		9·7636
3	...	8 49 52	31 50·8		9·7889
4	...	8 55 29	30 3·4		9·8133
5	...	9 0 16	+28 26·7	9·9255	9·8369

FIREBALLS IN JUNE.—Mr. Denning writes:—The twilight prevailing during the nights of the month of June is not favourable for meteoric work, but fireballs are often numerous and easily seen. During the first week of June many large meteors have appeared from a radiant in Scorpio at about 252°–22°, and they have had unduly long flights and slow motions. There are other striking radiants in Ophiuchus and Antinous. This year a special effort will be made by observers near the end of the month, with the object of ascertaining whether there is any repetition of the rich shower which occurred on June 28, 1916, and was presumably connected with the periodical comet of Pons-Winnecke. On that date the rich cluster of meteors through which the earth passed must have been more than 600 millions of miles from the cometary nucleus, so that the meteors are distributed along a very considerable section of the orbit, if indeed they do not form a complete elliptical stream.

KODAIKANAL OBSERVATORY REPORT.—Mr. Evershed's report on the work of the Kodaikanal and Madras Observatories during 1916 refers to several points of interest besides observations of a routine character. Solar observations were made on 342 days, and spectroheliograms in K light were obtained on 329 days. With the grating spectroheliograph photographs of the sun in H_{α} light were obtained on 258 days, and it was found that the number of absorption markings due to dense prominences on the disc had increased largely. It is interesting to note that visual spectroscopic observations were continued with reference to such phenomena as metallic prominences and displacements of the hydrogen lines, which are not readily photographed, and to furnish a check on the position angles determined from photographs. The spectrum of Venus was photographed with very high dispersion, and it is expected that besides yielding a fair value of the solar parallax, these plates will give valuable information as to the wave-lengths of solar lines on the side of the sun which is turned 90° or more from the direction of the earth. Mr. Evershed remained at Srinagar, Kashmir, until November 1. He reports that while the results obtained during the summer of 1916 confirmed his original estimates of the general excellence of the climate for solar work, the conditions during the months November to April inclusive did not appear to differ materially from those found in other localities; that is, the definition was generally good in the morning and evening, and poor near midday. In the summer months good definition throughout the day was the rule, and superlative definition was of quite frequent occurrence.

SOUTH GEORGIA.

THE island of South Georgia offers especially instructive evidence as to the geological history of the South Atlantic. Though one of the most isolated of the islands there, its structure is continental, and its geographical relations led Suess to the conclusion that it is a member of an island festoon which included the Falklands, Shag Rocks, Sandwich Islands, South Orkneys, South Shetlands, and Grahamland, and projected as a prolongation of the Andes into the South Atlantic, as the West Indies project into the tropical Atlantic.

South Georgia offers the best opportunities of deciding between Suess's theory and the alternative view that South Georgia and the Falklands are parts of an ancient South Atlantic land. Much new information as to the geology and geography of South Georgia was collected by Mr. D. Ferguson during a visit there made owing to the generosity of Mr. Theodore Salvesen, of Leith. Mr. Ferguson's results have been published in the Transactions of the Royal Society of Edinburgh (vol. l., part 4, Nos. 23–25, pp. 797–836, plates 81–94), and will be also issued in the Papers of the Geological Department of Glasgow University. Mr. Ferguson's account of the stratigraphical geology is illustrated by numerous excellent photographs, a geological map, and sections. This report is followed by papers based on Mr. Ferguson's collections dealing with the petrology by Mr. G. W. Tyrrell, and with the physical geography and palæontology. South Georgia is a long and narrow mountainous ridge, which rises to a height of more than 8000 ft. Its

FIG. 1.—Moraine Flat, glacier, small loch and stream, Cumberland Bay. From the Trans. Roy. Soc. Edinburgh.

central range, the Allardyce Mountains, is capped by perpetual snowfields, which feed numerous icefields and glaciers, some of which enter the sea, while others almost reach it, as is shown by Mr. Ferguson's photograph of Cumberland Bay (Fig. 1). Numerous spurs project north-westward from the central range and the coast is indented by an elaborate series of fiords and fiards. Mr. Ferguson claims that the scenery is the grandest and most picturesque in the Antarctic Islands of the South Atlantic. He compares it with that of north-western Scotland, and his beautiful photographs illustrate some of the resemblances between them. These arms of the sea form magnificent harbours, which are used by the South Atlantic whaling fleet. One of the chief centres, Leith Harbour, is shown in Fig. 2.

zoic, but that is an unsafe guide. The palæontological evidence is difficult of interpretation, for the fossils are badly preserved.

The first fossil was obtained in an erratic block at Moraine Fiord in Cumberland Bay by the Swedish Expedition under Dr. Otto Nordenskjöld; it is a lamellibranch which has been identified as a Mesozoic Posidonomya. Dr. König, of the German Antarctic Expedition under Lieut. Filchner, found an ammonite in the middle part of the Cumberland Bay series; Prof. Pompeckj says that it may be an Acanthoceras, and, if so, is Cretaceous. Some cherts, which were collected by Mr. Ferguson at Cape Pariadin, the south point at the extreme north-west end of the island, contain radiolaria. They have been examined by Dr. Hinde, who regards their age as probably between

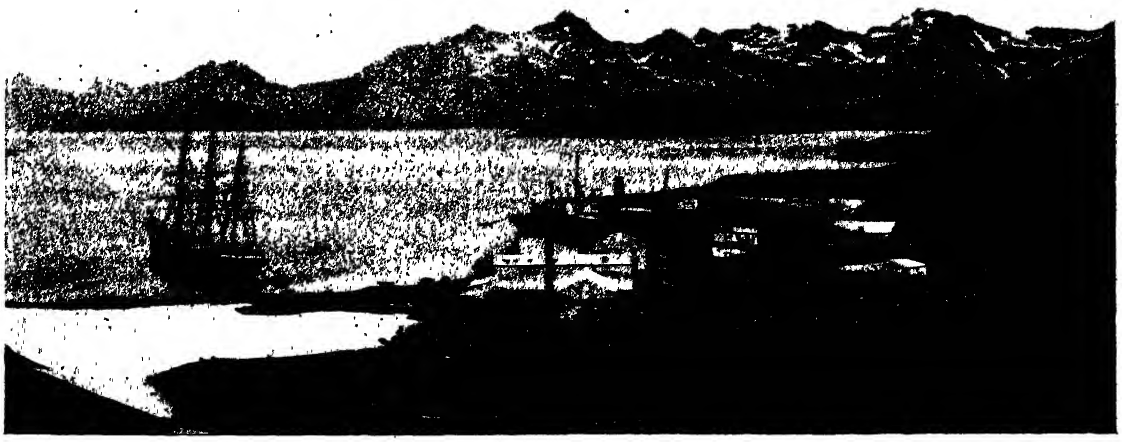

FIG. 2.—Leith Harbour, Stromness Bay, Whale Oil and Guano Works, South Georgia Co., Ltd. From the Trans. Roy. Soc. Edinburgh.

the Triassic and the Cretaceous; but their evidence is inconclusive, and Dr. Hinde remarks that this view might be modified by further knowledge of these radiolaria.

The island is mainly composed of sedimentary rocks, which have been much folded and faulted. At the south-eastern end of the island is an area of igneous rocks, amongst which Mr. Tyrrell has identified granite-porphyry, alaskite, quartz-trachyte, and felsite, and a sill of diabase occurs beside Cumberland Bay. Mr. Ferguson's field of work lay chiefly among the sedimentary rocks, which include phyllites, slates, mudstones, graywackes, cherts, and trachytic tuffs. Their composition is throughout generally similar, though the lowest rocks are the most altered and disturbed. Mr. Ferguson classifies the rocks into two divisions, a lower, or Cape George, series, and an upper, or Cumberland Bay, series. They are together more than 6000 ft. in thickness. The evidence as to the age of these rocks is conflicting. Their lithological character at first suggests that they are Palæo-

The Middle Cumberland Bay series therefore appears to be Mesozoic; but the fossils obtained from the Lower Cumberland Bay series in the promontory between Leith Harbour and Nansen Harbour, near the middle of the north-eastern coast, appear much older. The fossils are so crushed that their identification is only put forward tentatively. One of them appears to be a tabulate coral resembling Omphyma. It is associated with some fucoids which resemble *Buthotrephis succulens* from the Trenton Limestone of New York, and with some branched fossils referred to Camarocladia, which occur with Buthotrephis in the Trenton Limestone of Illinois. The fossils have been

examined by Dr. Bassler and Mr. Ulrich, of the National Museum, Washington, who regard them as nearest to Camarocladia. A fragment that may be part of a graptolite was also found, but it is too small for confident identification. The evidence at present available suggests that the lower part of the Cumberland Bay series is Silurian or Ordovician, while the middle and upper parts of the series are Mesozoic. The difficulty in this conclusion is that Mr. Ferguson recognised no stratigraphical break at the top of the Lower Cumberland Bay series; there may be a hidden disconformity which would be easily overlooked, as the rocks above and below that horizon consist of material derived from the same source.

The material collected by Mr. Ferguson is against rather than in favour of the view that South Georgia belongs to an Andean loop, for the igneous rocks that have been determined are of the alkaline or Atlantic, and not of the Pacific, type, and the sedimentary rocks are more allied to those of the eastern United States than to those of the Andes.

It is to be hoped that the island will soon be further examined to settle the problems which have been raised by Mr. Ferguson's useful work. Mr. Wordie, the geologist with Sir Ernest Shackleton's expedition, made an extensive collection of the igneous rocks from the south-eastern end of the island, but it was unfortunately lost by the wreck of the *Endurance*. His field observations will, however, doubtless throw much further light on the general geology of South Georgia.

J. W. GREGORY.

SOURCES OF NITROGEN COMPOUNDS.

IN the *Scientific American* for April 21 Prof. T. H. Norton contributes a valuable article under the heading, "American Sources of Nitrogen." Prof. Norton has given special attention to this important question, and the Department of Commerce published in 1912 an exhaustive report by him on "The Utilisation of Atmospheric Nitrogen." In 1916 Congress appropriated the large sum of twenty million dollars for the purpose of constructing and organising Government works for the production of nitrogen compounds available for military requirements and for general economic purposes.

After outlining the wide application of nitrogen compounds for agricultural purposes, emphasising the importance of ammonia and its compounds in industry, and nitric acid for the production of explosives and dyestuffs, the sources of combined nitrogen are considered, the principal being (1) Chile saltpetre; (2) ammonia; obtained as a by-product from the carbonisation of coal and lignites, and from Mond type gas plants working on coal, peat, etc.; from cyanamide by fixation of atmospheric nitrogen by calcium carbide; synthetically from hydrogen and atmospheric nitrogen by the Haber method; (3) nitric acid; from saltpetre, by the fixation of atmospheric nitrogen by the electric-arc process, and by the oxidation of ammonia by the Ostwald catalytic process. It is shown that Chile saltpetre is subject to wide fluctuations in price, being dependent on current demands, rates of freight, etc. The export duty of 11 dollars per ton levied by the Chilean Government is a heavy addition to cost. The economics of the various alternative methods outlined above are carefully considered in detail.

Cyanamide made at Niagara Falls, on an annual rate for electric power of 12 dollars per horse-power year (h.p.y.), is estimated to cost 28·74 dollars per short ton; 4·12 tons of 20 per cent. cyanamide will yield one ton of anhydrous ammonia; the cost of manufacture will be 30·80 dollars, so that the total cost of one short ton of anhydrous ammonia by this process is estimated to be 149·21 dollars. By the Haber method (synthetically from its elements) it is estimated that the cost should be reduced to 64 dollars per ton, but the method involves technical supervision of a high grade.

Turning to the cost of nitric acid, prior to the war the cost in New York for acid obtained from Chile saltpetre is given as 144·5 dollars per short ton (100 per cent HNO_3), the cost in Hamburg being equivalent to 96·32 dollars. By the Norwegian, or Birkeland and Eyde, process, with electric power at 12 dollars per h.p.y., the pure acid would cost 56·17 dollars. It is claimed that the new American Rankin arc process gives a yield 33 per cent. greater than the Norwegian process per unit of electric power, and Prof. Norton estimates that the cost of nitric acid might be reduced to 41·47 dollars. With reference to the Ostwald catalytic process, from information based upon statements of results in a Belgian plant he concludes that pure nitric acid, from ammonia obtained by the cyanamide process, would involve a cost of production of 63·68 dollars per short ton. In general this is the cost of nitric acid (100 per cent.) when anhydrous ammonia costs 150 dollars per ton.

RESEARCH INSTITUTIONS IN THE UNITED STATES.[1]

Federal Department of Agriculture.

WHEN the department was first organised, and for a number of years thereafter, its work was confined largely to matters directly affecting agriculture. Later, the Weather Bureau and the Forest Service were transferred to the department, and more recent legislation has charged the department with the enforcement of a number of regulatory laws, including those relating to meat inspection, animal and plant quarantine, foods and drugs, game and migratory birds, seed adulteration, insecticides and fungicides, and vaccines and viruses. The income of the department increased from 16,000*l.*, in 1863, to 727,000*l.*, in 1889. In 1915 the expenditure was 5,330,000*l.* There are now about 15,000 employees in the department. Of that number 3000 are employed at Washington, and 12,000 elsewhere. Nearly 2000 persons are engaged in scientific investigations and research, 1400 in demonstration and extension work, and 700 in administrative and supervising work.

Agricultural Colleges and Experiment Stations.

The grants to agricultural colleges under the Acts of 1890 and 1908 are now fixed at 10,000*l.* to each of the forty-eight States, and to Porto Rico and Hawaii, and aid sixty-nine institutions. The total value of the property held by these agricultural colleges is approximately 32,000,000*l.*, and their annual revenue 7,000,000*l.*, of which about 700,000*l.* (10 per cent.) is derived from Federal grants under the above Acts, 3,600,000*l.* (52 per cent.) from State appropriations, and 2,700,000*l.* (38 per cent.) from tuition fees, endowments, and miscellaneous sources.

Statistics show that approximately 53 per cent. of the graduates of the agricultural colleges return to the farm, and that 95 per cent. devote themselves to agriculture in some form, including college and station work. Of those not graduating, practically all return to the land.

The Hatch Act, 1887, provided that in order to aid in acquiring and diffusing among the people of the

[1] From a Memorandum on the Organisation of Scientific Research Institutions in the United States of America by Mr. Gerald Lightfoot, issued by the Advisory Council of Science and Industry, Commonwealth of Australia.

United States information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there should be established experiment stations under the direction of the colleges organised under the Morrill Acts. A sum of 800*l.* per annum was granted to each State for the purpose of conducting researches and experiments. In 1906 the Adams Act was passed, and an additional sum of 100*l.*, increasing in five years to 300*l.* per annum, was granted to each State for that purpose. Not more than 5 per cent. of the annual grants can be used for the purposes of land or buildings.

There are fifty-two stations which receive grants under the two Acts, the total amount granted being 285,000*l.* The annual revenue of these stations from other sources is 748,000*l.*, including 515,000*l.* from the State Governments, making a total revenue of 1,033,000*l.*

A national system of agricultural extension work was provided by Congress by the passing of the co-operative Agricultural Extension Act of 1914, commonly known as the Smith-Lever Act. This Act provided that each State receiving the benefits of the Morrill, Hatch, and Adams Acts should inaugurate agricultural extension work in co-operation with the Federal Department of Agriculture.

For that purpose a sum of 200*l.* per annum was granted to each State (a total of 96,000*l.* per annum), and in addition a sum beginning at 120,000*l.*, and increasing over a period of seven years to 820,000*l.* per annum, is allotted annually to the respective States by the Secretary of Agriculture in the proportion which the rural population of each State bears to the total rural population of all the States. But no payment of these additional appropriations can be made until the State or local authorities have appropriated an equal sum for the maintenance of co-operative agricultural extension work.

All the States have agreed to co-operate under the provisions of the Smith-Lever Act, and formal agreements between the presidents of the State agricultural colleges and the Department of Agriculture have been signed defining the duties and functions of the two parties. In the fiscal year 1915–16 a sum of 216,000*l.* was allotted to the States under the Smith-Lever Act. In addition, direct appropriations amounting to 240,000*l.* were made by Congress for extension work. The total Federal contribution thus amounts to 456,000*l.* This is supplemented by 530,000*l.* from the States. This sum includes 120,000*l.* to offset the equivalent allotment by the Federal Government under the Extension Act. The total from Federal and State sources is, therefore, approximately 1,000,000*l.*

The Forest Service of the Department of Agriculture.

The Forest Service has charge of the administration and protection of the national forests, and also promotes the practice of forestry generally through investigations and the diffusion of information. The national forests are administered in seven main districts, each with its central office in charge of a district forester. The annual expenditure for administration and protection is about 950,000*l.*, the expenditure on permanent improvements 120,000*l.*, and the total receipts 490,000*l.*

In the year 1915 the investigational work of the Forest Service was brought under one direction by the establishment of the branch of research. During previous years the various investigations were correlated by means of investigative committees, but the establishment of a separate branch was deemed advisable to make such correlation more complete, and at the same time to segregate investigational work in accordance with the policy established for the whole department.

The activities transferred to the new branch were:—

(i) Sylvicultural investigations conducted at eight forest experimental stations to determine the best methods of forest management to use in handling the national forests.

(ii) The Forest Products Laboratory established at Madison at a cost of approximately 50,000*l.*, with an annual appropriation which has been increased for the year 1916–17 by 15,000*l.*, making a total of 42,000*l.* a year. The technical sections of this laboratory are (*a*) timber physics, (*b*) timber tests of mechanical properties, (*c*) wood preservation, (*d*) derived products, (*e*) pulp and paper, and (*f*) pathology. It is stated that the results obtained at this laboratory are of great industrial value.

(iii) Economic studies of the lumber and other wood-using industries.

(iv) Fire protection studies, and

(v) Statistical investigations.

The Reclamation Service (Irrigation).

This service was organised in 1902 as a branch of the Department of the Interior, to carry into effect the provisions of the Reclamation Act of that year.

The Reclamation Act, 1902, provided that all money received from the sale of public lands in sixteen of the western States (except 5 per cent. of the proceeds of sales, already set aside for educational purposes) should be reserved as an official fund to be known as the "Reclamation Fund," and to be used for the construction and maintenance of irrigation works in the States specified. The Secretary of the Interior was empowered to locate and construct irrigation works, and to reserve from sale lands required for public purposes. The acreage of the allotments must be such as in the opinion of the Secretary may be reasonably required for the support of a family, and the charges over a period of ten years must be sufficient to return to the reclamation fund the proportionate cost of construction. In this way a "revolving" fund, which now amounts to about 18,000,000*l.*, has been accumulated.

The Bureau of Standards.

The total number of employees in the bureau is about 400, of which 300 are scientific and technical men. The junior scientific men are ordinarily university graduates, who begin on a salary of from 200*l.* to 250*l.* a year. Laboratory assistants and associate physicists and chemists receive from 400*l.* to 600*l.* a year, and physicists and chemists from 600*l.* to 800*l.* It is stated that these salaries are too small. The bureau is frequently losing able men whose place can only be filled by those who are inexperienced. In 1915 the Eastman Kodak Company took six men from the bureau, and the General Electric Company took three. Some men, however, prefer to remain in the bureau even when offered large increases in salary from outside. It should be observed that the loss of men in this way is a defect only from the immediate point of view of the bureau. From the broader industrial aspect it is a distinct advantage to have a Government institution which trains men in research work to go out and take positions as experts in industrial enterprises.

The laboratory grounds cover an area of sixteen acres near Washington, D.C. Experience has shown that the efficiency of the work of the bureau is greatly increased by the location of the laboratories in a section free from the ordinary disturbances of city life. The cost of the land and buildings is approximately 200,000*l.*, and of the equipment about 85,000*l.* The annual expenditure is about 125,000*l.*

The Bureau of Mines.

The Bureau of Mines was established as a separate branch of the Department of the Interior in 1910. Its aims are: (*a*) to bring about greater efficiency and the prevention of waste in the extraction, preparation, and utilisation of mineral products, and (*b*) to secure the safety and health of workers in the mining industries.

In its work the bureau seeks the co-operation of all interested persons, and welcomes the assistance and advice of workmen's organisations, of technical societies, and of State officials and State Governments. It maintains an experiment station and mine at Pittsburgh, where research work is carried on, and where investigations are made as to mining explosions, miners' lamps, and mining equipment, and the efficiency of mine rescue apparatus.

The bureau has given special attention to investigating the causes and methods of prevention of coal-mine explosions, and to safeguarding the lives of coal miners. In addition, coal and other mineral fuels belonging to or for the use of the Government of the United States have been analysed and tested with the view of increasing efficiency in their utilisation. Investigations have been undertaken with the view of increasing the efficiency and preventing waste in the metal-mining and miscellaneous mineral industries, and a considerable amount of research and experimental work in regard to metallurgical problems has been carried out. The expenditure of the bureau is about 120,000*l.* per annum.

The Public Health Service.

The Public Health Service now consists of 450 medical officers and fifty pharmacists, in addition to professors, technical assistants, and other officers. The total staff numbers about 2000, while the annual expenditure is now about 600,000*l.* In the United States public health matters within the limits of any one State are reserved to the States themselves, but the Federal Public Health Service has a broad field of activities, inasmuch as it is responsible for preventing the importation of disease and the spread of disease from State to State, and for assisting the States in the solution of various public health problems.

Through the Public Health Service, the Federal Government co-operates with the health authorities of the States individually and collectively; collects current information of the prevalence and geographic distribution of disease; is responsible for the administration of the inter-State quarantine laws and regulations for the prevention of the spread of disease from State to State; suppresses epidemics; carries on research work in matters pertaining to the public health; maintains the national quarantine for the prevention of the importation of disease from abroad; performs the medical examination of emigrants; regulates the manufacture and sale of vaccines, serums, anti-toxins, and analogous products in inter-State traffic; and furnishes medical care and treatment to various branches of the Government service and to the seamen of the merchant marine.

The Division of Scientific Research controls all matters relating to investigations of contagious and infectious diseases, and matters pertaining to the public health wherever made. In the field it is represented by the Hygienic Laboratory, with its four branches—(*a*) the Plague Laboratory in San Francisco, (*b*) the Leprosy Investigation Station in Hawaii, (*c*) the Pellagra Investigation Station at Savannah, and (*d*) the Station at Wilmington for the investigation of the parasites of man—and by officers engaged in investigations of typhoid fever, Rocky Mountain spotted fever, and other diseases.

The Smithsonian Institution, Washington.

This institution was founded in 1846 under the terms of a private bequest, by which a sum of approximately 100,000*l.* was donated to found "an establishlishment for the increase and diffusion of knowledge among men."

With a view to the increase of knowledge, the institute aids investigators by making grants for research and exploration, supplying books, apparatus, laboratory accommodation, etc. It occasionally provides for lectures, which are published. It has initiated numerous scientific projects, some of which have been turned over to the Government, and resulted in the creation of independent Government bureaux. It advises the Government in many matters of scientific importance, especially in those that have an international aspect. It co-operates with national scientific bodies, such as the National Academy of Sciences, the American Association for the Advancement of Science, the American Historical Association, etc.

The parent institute has the administrative charge of several branches which grew out of its early activities, and are supported by Congressional appropriations. These are the National Museum, including the National Gallery of Art, the International Exchange Service, the Bureau of American Ethnology, the National Zoological Park, the Astrophysical Observatory, the Langley Aerodynamical Laboratory, and the United States Regional Bureau for the International Catalogue of Scientific Literature.

STATE INSTITUTIONS.

Universities.

A large amount of research work is carried on in the universities and other higher educational institutions in the United States in respect both to pure science and to industrial problems. A great part of the research work conducted in these institutions is of a purely scientific nature, and is on the same general lines as that carried out in English and Australian universities. In the "State" universities in America there is, however, a greater tendency for the research work to be more directly associated with the industrial needs and progress of the community. These State universities were established from the revenue derived from land grants, and are maintained partly by means of these grants and partly by means of special taxes on rateable property. In so far as the agricultural and engineering experiment stations are concerned, research work has already been linked up with industry, and proposals have recently been made for the establishment of a National University at Washington, which would serve to organise the work of existing universities on lines more closely related to industrial interests.

Experiment Stations.

Agricultural Experiment Stations.—Reference has already been made to the agricultural experiment stations established under the Hatch and Adams Acts, and to the relations between the Federal and State authorities with respect to these stations. The research work of the stations covers the whole field of scientific agriculture.

Engineering Experiment Stations.—Experiment stations have been established at several of the universities in the United States. These stations have special staffs of officers who are free from ordinary instructional work. Their most important activities are generally in relation to engineering problems, but several of them are also engaged partly in investigational work connected with mining and other special industries. The engineering experiment station at the University of Illinois may be taken as typical of

the best organised and most highly developed of these stations.

The Illinois experiment station was organised in 1903 for the purpose of conducting investigations of importance to professional engineers and to the manufacturing, railway, mining, and building interests of the State. One important factor which led to the establishment of the station was the success which had attended the agricultural experiment station at the same university. It was thought that its establishment was justified in view of the need for scientific research and the application of science to industry.

The cost of maintenance of the Illinois station is about 10,000*l.* a year.

PRIVATELY ENDOWED INSTITUTIONS.

The Carnegie Institution, Washington.

The Carnegie Institution of Washington was founded by Andrew Carnegie in 1902, when he gave to a board of trustees an endowment of registered bonds of the value of 2,000,000*l.*; to this fund he added later the sum of 2,400,000*l.*; so that the present endowment of the institution is 4,400,000*l.*, yielding an annual interest of 220,000*l.*

The articles of incorporation of the institution declare in general "that the objects of the corporation shall be to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind." Three principal agencies to forward these objects have been developed. (*a*) The first of these involves the formation of departments of research within the institution itself, to attack larger problems requiring the collaboration of several investigators, special equipment, and continuous effort. (*b*) The second provides means whereby individuals may undertake and carry to completion investigations not less important, but requiring less collaboration and less special equipment. (*c*) The third agency, namely, a division devoted to editing and printing books, aims at the publication of the results of research coming from the first two agencies, and, to a limited extent, also for valuable works not likely to be published under other auspices.

The Mellon Institute.

The Mellon Institute of Industrial Research and School of Specific Industries is a privately endowed institution, and is unique in its organisation. It was established with a twofold object, viz. (*a*) to solve problems submitted to it by those engaged in industry, and (*b*) to train young men successfully to prosecute research work. The institute is worked on a system known as the "Industrial Fellowship System." According to this system, an individual or a company having a problem requiring solution may become the donor of a fellowship by contributing to the institute a definite sum of money, for a period of not less than one year. This money is used to pay the salary of the man or men selected to carry out the investigation desired, and the institute furnishes such facilities as are necessary for the conduct of the work. The results obtained belong exclusively to the donor of the fellowship.

The system was inaugurated in 1911, in the Department of Industrial Research of the University of Pittsburgh, and the working of the scheme began in a temporary building erected at a cost of about 2000*l.* In 1913 the present institution was established on a permanent basis by a private endowment of about 100,000*l.* While the institute is an integral part of the University of Pittsburgh and works in close connection with the University, it possesses an endowment of its own and is under its own management. The present annual expenditure for salaries and maintenance is more than 30,000*l.*

The Rockefeller Institute, New York.

The scheme of organisation of this institute is of special interest, as it is regarded by many as ideal for a scientific institution established for a specific field of research. The work of the institute began in 1901, when Mr. J. D. Rockefeller promised the sum of 40,000*l.* per annum for ten years for the purpose of "medical research with special reference to the prevention and treatment of disease." The endowments were greatly increased in ensuing years, and by 1907 reached a total of 700,000*l.* for land, buildings, and equipment, and a fund of 2,100,000*l.* for maintenance. In addition, 200,000*l.* has been given for the equipment and endowment of a department of animal pathology, 100,000*l.* for a pension fund, besides other sums for specific investigations.

The experience of the institute in regard to research work is that the best method is to map out a field in which the more pressing problems arise; then to obtain the best man available in each branch, and to allow him to associate with himself assistants and collaborators and attack the problems in such ways as he may think fit. All that is necessary in the way of supervision is that some broad policy should be agreed upon, *i.e.* as to the general lines of the work and the most important problems, the solution of which is considered feasible in view of the existing state of scientific knowledge. Having decided these broad lines of policy, it is best to allow the persons selected for the research to work the problems out in any way and at such times as they like. It is quite probable, for example, that in attacking some one problem discoveries may be made which will lead directly to the solution of some other allied problem. In the Rockefeller Institute the greatest freedom is allowed to the members in charge of the various laboratories. They know what it is desired to accomplish, but whether to pursue any particular line, or to continue in that line, is left to their discretion. Two things are considered essential in research work, viz. :—

(*a*) To secure the best men available to undertake the research work, and to allow these men to choose their own associates.

(*b*) To give the men appointed the greatest freedom in the prosecution of their researches.

Public pressure is frequently brought to bear upon the Rockefeller Institute to solve particular problems, but the question as to which problems are to be investigated must depend very largely on the state and progress of knowledge in the particular branch of science involved. For example, the institute has often been asked to investigate "hay-fever," but it has refused, as it sees at present no likelihood of solving the problem.

In regard to the separation of research from instructional work the experience is that the best teachers are undoubtedly those who do research work, but it does not by any means follow that the best research men are those who also do instructional work. The question is largely one of temperament.

INDUSTRIAL LABORATORIES.

A large amount of research work having a direct industrial objective is done by private firms in the United States of America. Many large industrial concerns have established their own laboratories and staffs for research work, and in this respect considerable developments have taken place during the past ten years. It is stated by Mr. A. P. M. Fleming, of

the British Westinghouse Company, Ltd. (who visited the United States in the year 1915 for the purpose of inquiring into the organisation of industrial research), that there are probably more than fifty industrial concerns which have established research laboratories on an extensive scale, and that many of these laboratories expend from 20,000*l.* to 60,000*l.* a year on research work.

The Eastman Kodak Company.—The laboratories of this company at Rochester, N.Y., are maintained at an annual cost of about 20,000*l.*, and are generally considered to be among the finest in the country.

The Mulford Company.—This company, founded in 1894 at Philadelphia, affords an excellent illustration of what can be accomplished by the adoption of scientific research and the application of science to industry. The company now has a capital of 400,000*l.*, it employs 1400 persons on wages, and its scientific staff comprises about sixty graduate chemists, pharmacists, bacteriologists, and physicians. The company manufactures drugs, and specialises in the production of serums, anti-toxins, and vaccines.

The American Rolling Mill Company.—This company, which has a number of factories, is a large producer of sheet iron and steel. The laboratories comprise works laboratories in which routine testing and the elimination of manufacturing troubles are dealt with, and a separate research laboratory, established in 1910 at a cost of 10,000*l.*

The Detroit Edison Company.—This company maintains a small research laboratory, partly for the purpose of investigating troubles incident to the smooth working of the technical side of the enterprise, and partly for investigating the utilisation of electrical energy for special purposes.

The National Electric Lamp Association.—This association comprises about twenty electric lamp factories in different parts of the States. The research laboratories, at which there are about 200 employees, comprise fifteen separate laboratories, in addition to a model lamp factory, in which the results of laboratory investigations are tested and developed on a manufacturing scale. Another laboratory is maintained for testing and standardising the products of the factories. There is also a separate department which specialises in the development of automatic tools for lamp making. The scientific and technical members of the staff are drawn almost entirely from the universities.

The Pennsylvania Railway Company.—This company has an extensive research laboratory with a staff of more than 300. The investigations are connected mainly with materials utilised in railway work, and elaborate chemical, physical, and electrical equipment is provided. There is also a laboratory on a workshop scale used for the development of results obtained in the research laboratories.

The National Cash Register Company.—The research laboratory of this company at the works at Dayton, Ohio, is equipped for chemical, physical, and microscopic investigations. The staff of the laboratory numbers fifteen, about two-thirds of whom are university or technological college graduates. But little work of a purely scientific nature is undertaken, the investigations being directed mainly to the elimination of manufacturing troubles and improvements in the materials used.

The General Electric Company.—This company organised a department of chemical and physical research in 1901, with an initial capital expenditure of about 3000*l.*, and an annual expenditure of 600*l.* The investigations undertaken were connected directly with the field of electric engineering. At the present time the capital expenditure on the laboratory exceeds 100,000*l.*, while the annual expenditure is about 50,000*l.* The staff comprises about 200 men.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—An offer from the Rhodes Trustees to subscribe 50*l.* a year for three years for the provision of secretarial assistance for the Standing Committee of the Imperial Studies Committee has been accepted by the Senate with thanks.

The thanks of the Senate have been accorded to the Society of Antiquaries for the renewal for a further period of five years of the Franks studentship founded by them in memory of Sir A. Wollaston Franks, K.C.B., for the promotion of the study of the archæology of the British Isles in its comparative aspects.

The following doctorates have been conferred:—*D.Sc. in Psychology*: Mr. E. N. McQueen, an internal student, of University College, for a thesis entitled "The Distribution of Attention"; *D.Sc. in Botany*: Miss Lilian J. Clarke, an external student, for a thesis dealing with various experiments in botany gardens, and other papers; Mr. R. C. Knight, an external student, for a thesis entitled "The Interrelations of Stomatal Aperture, Leaf Water-content, and Transpiration Rate," and other papers; and Mr. S. G. Paine, an external student, for a thesis entitled "The Permeability of the Neash Cell," and other papers.

As was explained in these columns at the time, the Board of Education in July, 1914, proposed in Circular 849 to institute two annual examinations, a lower and a higher, for grant-earning secondary schools, to be conducted by university examining bodies in close co-operation with the Board of Education. In January, 1916, the Board announced that the proposals must be considered to be in abeyance, as the necessary financial aid was not forthcoming. The Board of Education now announces in Circular 996 the formation of a Secondary Schools' Examinations Council, the main function of which, we learn from the *Times*, will be the co-ordination of the numerous examinations to which secondary schools at present submit their pupils. The new council is to consist of eighteen persons, appointed by the universities and other bodies, including four by the Teachers' Registration Council.

THE Appointments Board of the University of London has issued a pamphlet describing its aims and work. Founded eight years ago, it has had its own secretary for the last six years, and has dealt with 2500 students and graduates, for many of whom it has found posts. While a large proportion of the posts filled have been in the teaching profession, the board is endeavouring to induce a greater number of graduates to enter business houses, and, on the other hand, is pointing out to employers the advantages of having well-educated men and women on their staffs. The present pamphlet gives no hint to intending clients as to the directions in which business openings are most likely to be found, but in a recent report of the board to the Senate of the University it was stated that a great demand exists at the present time for men and women with a scientific training in engineering, physics, or chemistry, and that this demand would probably continue after the war. The supply of such men and women is altogether too inadequate, and it seems to be the duty of our universities to increase the supply as soon as possible. If the experience of the Appointments Boards of the other universities is in any way like that of the London board, the fact is of great interest to the parents of future university students, and should not remain buried in the minutes of university bodies, but should be made known to the public without delay.

WE have received from Mr. Gilbert H. Richardson, of The Gables, Elswick Road, Newcastle-on-Tyne, a "Declaration concerning the Need for Standardising Auxiliary International Language," which he invites the readers of NATURE to sign. The declaration states that there is need for an international language, that there should be only one such language, and that at the close of the war a permanent International Commission should be appointed and financially supported by the Governments of the Powers for the purpose of settling all questions relating to the grammar, vocabulary, orthography, and pronunciation of the auxiliary international language. At the present time there are two such languages, "Esperanto," founded by the late Dr. Zamenhoff, and "Ido," which was proposed in 1901 as a simplification of Esperanto. It is now proposed that there should be a commission to examine both these languages, with power to impose its decisions upon those who wish to employ an international language. Should the commission decide in favour of either Esperanto or Ido, the report would promote the use of the language recommended. In the event, however, of yet a third language being drawn up by the commission, it is doubtful whether Esperantists and Idists would be prepared to adopt this new tongue. The verdict of the commission would depend largely upon its composition. We suppose that the French, Italian, and Spanish members would vote for Ido, while members of the Slav nationalities would support Esperanto. The terminations "aj," "oj," and "uj," constantly occurring in Esperanto, are disconcerting to English readers, who will certainly prefer the general appearance of Ido, which, when printed, looks remarkably like Italian. The circumflex accents over certain consonants, which make Esperanto difficult to print, are discarded in Ido. On the whole, we think that of the two languages Ido would be the more easily acquired by an Englishman.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, May 16.—Dr. Alfred Harker, president, in the chair.—T. **Sheppard**: British geological maps as a record of the advance of geology. Geological changes were often indicated on old topographical maps; consequently, old plans and charts were of use in connection with geological inquiries. Some maps, dating from Elizabethan times, show that in the Humber area great changes have taken place; large tracts of land have been denuded, and many towns and villages have disappeared; and large stretches of reclaimed land marked places where water once stood. Writers of 1595 were familiar with lithological differences in various parts of the country. Strachey (1719) and Packe (1743) produced some remarkable geological sections and plans. The first systematic series of maps, illustrating the geological features of the counties, was issued in the reports of the old Board of Agriculture, and dated from 1793 to 1822. One of the earliest attempts to prepare geological maps was by Prof. Jameson, who read a paper in 1805 "On Colouring Geognostical Maps" (Wernerian Nat. Hist. Soc., vol. i., published 1811). The first strictly geological map was apparently that made by W. Smith in 1799, showing the geological structure of the Bath district. The first geological map of England and Wales was a small one, also by Smith, and it was presented to the society when the first Wollaston medal was awarded to Smith in 1831. The society's collection includes geological maps of Scotland and Ireland, some of great value and historical interest. As examples of privately published maps, those by Sanders of the Bristol Coalfield, Jordan's London district, and Elias Hall's Lancashire area were described.

MANCHESTER.

Literary and Philosophical Society, May 8.—Mr. W. Thomson, president, in the chair.—R. F. **Gwyther**: The specification of stress. Part v. The formal solution of the statical stress equations, and a theory of displacement as consequent on stress. The first portion of this paper is intended to show how the stress equations, given in part iv. and part iv. continued, are capable of simple general solution. Particular integrals are supposed to be dealt with separately, and no attempt has been made to treat of any specific problem. The aim has been to establish a basis for a theory of dealing with stress and displacement by continual steps of approximation, developed in the second part of the paper. In the second part the theory and method proposed are described.—Dr. E. **Newbery**: Recent work on overvoltage. The overvoltages, cathodic and anodic, of a number of electrodes have been measured in acid, in alkali, and in certain solutions of metallic salts under varying conditions of time and current density. Elements in the same group of the periodic system show the same cathodic (hydrogen) overvoltage. Overvoltage is due to the high solution potentials of compounds of the electrode material with the discharged ion, or with a product of the discharged ion. These compounds (hydrides, higher oxides, etc.) form solid solutions in the electrode substance, and are usually stable only under the influence of high pressures or high temperatures. Metal overvoltages (during deposition or dissolution of the metal) are due to the presence of the same compounds which produce gas overvoltages, and are in most cases very low compared with gas overvoltages. Iron, nickel, and cobalt are exceptions to this rule. Changes of overvoltage are produced (*a*) by changes of constitution of the above compounds, and (*b*) by changes of concentration of the solid solutions formed. Passivity is due to the insolubility and good electrical conductivity of the above compounds, which form a protective coating over the attackable metal surface

PARIS.

Academy of Sciences, May 14.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: Solutions of the problem of thrust, resembling that of Rankine and Maurice Lévy for sand, and sustaining walls of rectilinear profile.—H. Le **Chatelier** and F. **Bogitch**: The refractory properties of clay. From a study of the melting points, it would be concluded that refractory clay bricks ought to serve for the construction of industrial furnaces in steel works. This is not found to be the case in practice, silica bricks being exclusively employed. It is shown that the gradual softening of the clay bricks and loss of resistance to pressure are the causes of this difference, and experiments on the alteration of shape by pressure at increasing temperatures are given. The results are in general agreement with the work of Mellor and Moore.—H. **Douvillé**: The geology of the country to the west of the Pyrenees chain.—L. **Mangin**: Arctic forms erroneously described under the name of *Chaetoceros criophilus*. The Arctic form belongs to a quite different species, and is allied with *C. peruvianus*, with which it has often been confused.—E. **Ariès**: The absolute value of entropy and energy.—E. **Kogbetliantz**: The summation of ultraspherical series.—M. **Pétrovitch**: Arithmetical theorems on Cauchy's integral.—J. **Guillaume**: Observations of comets made with the *coudé* equatorial at the Observatory of Lyons. Observations of Wolf's comet (1916*b*)

on April 26, 27, 28, and May 2, and of Schaumasse's comet on April 27, 28, and May 2.—MM. **Garvin** and **Portevin**: Experimental study of the cooling of various metals by water. A description of experiments on the determination of the cooling curves of metals and alloys suddenly immersed in cold water.—J. de **Lapparent**: The breccias of the Cretacean age in the neighbourhood of Hendaye.—L. **Bordas**: Some points on the anatomy of *Tortrix viridana*.—E. **Sollaud**: The post-cephalic appendages of the Branchiopods and their morphological signification.—A. **Frouin** and R. **Grégoire**: The action of metallic tin and oxide of tin in staphylococcus infections. Tin can be absorbed by the digestive apparatus from metallic tin and from oxide of tin without poisonous effects. The therapeutic value in experimental staphylococcus infections was proved.—R. **Wurtz** and R. Van **Malleghem**: Grave attacks in the so-called benign tertiary fever.

BOOKS RECEIVED.

The Advanced Atlas of Physical and Political Geography. By Dr. J. G. Bartholomew. Pp. 96+general index, pp. 31. (Oxford: University Press.) 8s. 6d. net.

Annual Chemical Directory of the United States. Edited by B. F. Lovelace. Pp. 305. (Baltimore: Williams and Wilkins Co.) 5 dollars.

Treatise on Hydraulics. By M. Merriman. Tenth edition. Revised, with the assistance of T. Merriman. Pp. x+565. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18s. 6d. net.

A Treatise on the Analytical Dynamics of Particles and Rigid Bodies, with an Introduction to the Problem of Three Bodies. By Prof. E. T. Whittaker. Second edition. Pp. xii+432. (Cambridge: At the University Press.) 15s. net.

British Forestry, Past and Present. By Prof. W. Somerville. Pp. 19. (Oxford: University Press.) 6d. net.

Radiodynamics: the Wireless Control of Torpedoes and other Mechanisms. By B. F. Miessner. Pp. v+206. (London: Crosby Lockwood and Son.) 9s. net.

Experimental Building Science. By J. L. Manson. Vol. i. Pp. vii+210. (Cambridge: At the University Press.) 6s. net.

Refractory Materials. Pp. 189. (London: The Faraday Society.) 12s. 6d. net.

Advanced Text-Book of Magnetism and Electricity. By R. W. Hutchinson. Two vols. Vol. i., pp. vii+372+xii. Vol. ii., pp. vi+468+xii. (London: University Tutorial Press, Ltd.) Two vols., 8s. 6d.

The Causes of Tuberculosis: together with Some Account of the Prevalence and Distribution of the Disease. By Dr. L. Cobbett. Pp. xvi+707. (Cambridge: At the University Press.) 21s. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. i., 1916. Pp. 335. (London: Harrison and Sons.)

Magnetism and Matter. By Kôtarô Honda. Pp. 320+4+3. (Tokyo: Syôkwabo.)

One Hundred Points in Food Economy. By I. G. Ramsay. Unpaged. (London: G. Bell and Sons, Ltd.) 1s. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 31.

ROYAL INSTITUTION, at 3.—The Art of the Essayist: A. C. Benson.

FRIDAY, JUNE 1.

ROYAL INSTITUTION, at 5.30.—The Brontës; A Hundred Years After: J. H. Balfour Browne.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Post-Pliocene Non-Marine Mollusca of Ireland: A. S. Kennard and B. B. Woodward.

SATURDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

MONDAY, JUNE 4.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—British Honduras: Brigadier-General Sir Eric Swayne.

VICTORIA INSTITUTE, at 4.30.—Some of the Relations between Science and Religion as affected by the Work of the last Fifty Years: The Very Rev. H. Wace.

TUESDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—The Flow of Ice and of Rock: Prof. W. W. Watts.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Links of North and South: Prof. W. M. F. Petrie.

ZOOLOGICAL SOCIETY, at 5.30.—Exhibition on behalf of Messrs. Rowland Ward of Two Zebra-skins showing Abnormal Pattern: R. I. Pocock.—The Poultry Exhibition: D. Seth-Smith.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.—*Resumed Discussion:* The Future of the British X-Ray Industry: Captain R. Knox.

WEDNESDAY, JUNE 6.

GEOLOGICAL SOCIETY, at 5.30.—The Geology of the Old Radnor District, with special reference to Algal Development in the Woolhope Rocks: Prof. E. J. Garwood and Miss E. Goodyear.—A Contribution to Jurassic Chronology: S. S. Buckman.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Some Experiences in the Use of Copper Sulphate in the Destruction of Algæ: G. Embrey.—(1) A Combined Reichert-Polenske and Modified Shrewsbury-Knapp Process; (2) The Differentiation between Coconut and Palm Kernel Oils in Mixtures: G. D. Elsdon.—Orange Pip Oil: Dorothy G. Hewer.—The Estimation of Theobromine: Norah Elliott and G. Brewer.—Rapid Estimation of the Strength of Sulphuric Acid: H. D. Richmond and J. E. Merreywether.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—The Art of the Biographer: A. C. Benson.

FRIDAY, JUNE 8.

ROYAL INSTITUTION, at 5.30.—Industrial Applications of Electrons: Sir J. J. Thomson.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, JUNE 9.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—The Conception of a Cosmos: Prof. J. S. MacKenzie.

SUNDAY, JUNE 10.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—Symposium: Are the Materials of Sense Affections of the Mind?: Dr. G. E. Moore, W. E. Johnson, Prof. G. Dawes Hicks, Prof. J. A. Smith, and Prof. James Ward.

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Editorial and Publishing Offices:
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Advertisements and business letters to be addressed to the Publishers.

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THURSDAY, JUNE 7, 1917.

BOOKS ON CHEMISTRY.

(1) *Elementary Qualitative Analysis: A Laboratory Guide.* By Prof. B. Dales and Dr. O. L. Barnebey. Pp. vii+205. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5*s*. 6*d*. net.

(2) *Laboratory Manual of General Chemistry, with Exercises in the Preparation of Inorganic Substances.* By A. B. Lamb. Pp. vi+166. (Cambridge, Mass.: Harvard University Press, 1916.) Price 1.45 dollars.

(3) *A Text-book of Organic Chemistry for Students of Medicine and Biology.* By Prof. E. V. McCollum. Pp. xiii+426. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 10*s*. net.

(1) ALTHOUGH the value of instruction in qualitative analysis is far more dependent upon the teacher than upon the text-books provided for the students' guidance, much useful assistance is to be gained from the latter if they are based upon a sound method of experiment and observation. From this point of view the "Laboratory Guide to Elementary Qualitative Analysis" by Prof. Dales and Dr. Barnebey merits the attention of teachers in this country. The book is designed for the use of students who have done a year's work in general chemistry. The principles of qualitative analysis as based upon the theory of electrolytic dissociation are dealt with in an introductory chapter, which should prove helpful to students in bringing their experimental work into line with their training in general chemistry. An outstanding feature of the details of qualitative analysis is that the reactions of the several groups of bases and acids are studied comparatively with each of the reagents employed, instead of by the more usual method in which the tests for each base or acid are dealt with separately. This method of treatment has distinct advantages, especially as a training in the methods of observation. The group-tables for bases are similar to those usually employed, but the scheme for the detection of acids is somewhat new and is based upon the precipitation of the silver salts in distinctly acid and in neutral or slightly acid solution respectively. The instructions are clear, concise explanatory statements add considerably to their value, and the purpose of qualitative analysis as a basis for the further practical study of chemistry is very satisfactorily explained.

(2) The object of Prof. Lamb's "Laboratory Manual of General Chemistry" is to widen the horizon of study of first-year university students who have had a previous training in chemistry at a secondary school, and at the same time to stimulate their further interest in important generalisations of the science by means of experiments of a less familiar kind than those with which they have been previously acquainted. With these aims in view a number of quantitative experiments are described requiring varying degrees of previous knowledge and experimental skill, together with a series of semi-quantitative experiments in the more elementary portions of physical chemistry. The directions for each experiment comprise suggested reading from some standard text-book, a discussion of the general principles involved in the experiment, directions for the actual manipulation, tests and questions. Appended to each of the instructions is a blank sheet for laboratory notes; these are to serve as the basis for a full and connected account of the work done, which is afterwards to be written up.

Such attempts to combine instruction in theory with details of experiment and series of questions in a laboratory text-book are seldom satisfactory in actual practice. They are apt to stereotype the teaching, to take too little account of the individual difficulties of students, and to absolve the teacher of his real responsibilities. The selection of the experiments and preparations is for the most part sufficiently wide to provide a useful curriculum, but the descriptive headings and discussions are in many cases considerably more advanced than the actual laboratory experiments. Also, a number of the exercises, such as the determination of the electrical conductivity of a solution, the preparation of hydrazine sulphate and of chloropentamine cobaltic chloride, are much beyond the knowledge and manipulative capacity of an average first-year student in this country.

(3) The importance of organic chemistry to students of medicine and biology fully justifies the publication of an additional text-book if it serves their special requirements satisfactorily and stimulates their interest in the subject. These objects are very successfully achieved by Prof. McCollum's book. The subject-matter is presented in a clear and attractive form, the sequence of the compounds described is chosen with care and with an advantageous departure from the usual order, and suitable prominence is given to the methods of preparation, properties, and synthetical relations of substances of biological and physiological importance. Details in regard to laboratory and technical processes are intentionally restricted. Whilst this is not necessarily disadvantageous, the danger of introducing "paper chemistry" is not altogether avoided, as in the scheme of oxidation of alcohol to oxalic acid (p. 201), in which the stages of oxidation represented are not in accord with experimental methods.

Theoretical studies such as stereochemistry are developed as individual compounds come under consideration, a method of treatment which should appeal to the interest of students, although it necessitates a considerable use of cross-references. The prominence given to Nef's views on divalent carbon is somewhat out of proportion to the space allotted to other and more fully established views on the structure of organic compounds. References to recent work are very suitably introduced, and the more special chapters included in the book, such as those on fats and waxes, the ureides, the pyrimidines, pyrazines, and purins, and the carbohydrates, are well adapted to their purpose.

C. A. K.

THEOPHRASTUS.

Theophrastus: Enquiry into Plants, and Minor Works on Odours and Weather Signs. With an English translation by Sir Arthur Hort, Bart. (Loeb Classical Library.) In 2 vols. Vol. i., pp. xxviii+475; vol. ii., pp. ix+499. (London: W. Heinemann; New York: G. P. Putnam's Sons, 1916.) Price 5s. net each vol.

ENGLISH botanists are under a great debt of obligation to Sir Arthur Hort for this edition of some of the principal works of Theophrastus, and they are also greatly indebted to Sir William Thiselton-Dyer for his labours in the difficult task of identifying the various plants named by the Greek botanist. Death alone prevents our adding another name to whom thanks are due, for the enterprise owes its origin to the suggestion of the late venerable Canon Ellacombe, who took the greatest interest in the preparation of the work. It is to be hoped that hereafter the other writings of Theophrastus will follow in a similar edition.

The primary classification of plants by Theophrastus is into four divisions, namely, trees, shrubs, under-shrubs, and herbs. There are other categories under which he gathers his species—some of a very artificial character, such as pot-herbs and coronary flowers. There are also glimpses here and there of his recognition of natural groups, and he is conscious that the grasses are closely related to one another. He knows the leguminous plants as a group, to which he frequently refers, and, what is remarkable, he is acquainted with the fact that a crop of such plants enriches the land. He recognises the conifers as a group and mentions them under that name.

The book contains a large amount of information, often of a vague and discursive and hearsay character, as to the localities where trees and plants grow, and the different effects of climate and situation. Theophrastus is often content to rest upon the reports of others, and many statements are introduced by such phrases as "They say," or "The men of Mount Ida say," or "The men of Macedonia say." One is inclined to think that he listened to reports from his numerous students and accepted them with little or no investigation.

The account of the collection of myrrh and frankincense and the other Arabian gums is very curious.

Incidentally the work throws considerable light on the traditional lore of the Attic gardeners, who were probably a pretty numerous class. They seem to have grown a large variety of pot-herbs, as well as flowers. The work also throws a curious light on the arts of carpentry and joinery, on the conversion of reeds into pipes, and on the development of the knowledge of drugs and the art of poisoning as well as of the administration of antidotes.

According to Theophrastus, the druggist is not far removed from the poisoner:—

Thrasyas of Mantineia had discovered, as he said, a poison which produces an easy and painless end; he used the juices of hemlock, poppy, and other such herbs, so compounded as to make a dose of conveniently small size, weighing only somewhat less than a quarter of an ounce. For the effects of this compound there is absolutely no cure, and it will keep any length of time without losing its virtue at all. He used to gather his hemlock, not just anywhere, but at Susa [probably a place in Arcadia] or some other cold and shady spot; and so, too, with the other ingredients; he also used to compound many other poisons, using many ingredients.... Now these things seem to have been ascertained better in recent than in former times. And many things go to show that the method of using the various drugs makes a difference; thus the people of Ceos formerly did not use hemlock in the way described, but just shredded it up for use, as did other people; but now not one of them would think of shredding it, but they first strip off the outside and take off the husk, since this is what causes the difficulty, as it is not easily assimilated; then they bruise it in the mortar, and, after putting it through a fine sieve, sprinkle it on water and so drink it; and their death is made swift and easy. (Vol. ii., IX. xvi. 9.)

In dealing with the sea-plants, there seems to be a suggestion of correspondence with plants on the land. This is implied by the names "sea-fir," "sea-oak," "sea-vine," and "sea-palm," and a "kind like dog's-tooth grass." There is a distinction between the sea-plants found near the shore and those of deeper waters, and these again are distinguished from plants which grow in rivers and marshes and lakes.

In conclusion, we can heartily recommend the book to all who are interested in the history of botany, or in the details of Greek life three hundred years B.C.

E. F.

OUR BOOKSHELF.

Rivers as Sources of Water-Supply. By Dr. A. C. Houston. Pp. vi+96. (London: John Bale, Sons, and Danielsson, Ltd., 1917.) Price 5s. net.

A "COUNSEL of perfection" is for every community to obtain its water-supply from a source which, like Cæsar's wife, should be "above suspicion." But many communities have to depend upon a supply which falls short of this high standard. This is more particularly the case with reference to the London water-supply, which is drawn mainly from the rivers Thames and Lea; and it is with this supply that Dr. Houston deals in the book under review. The observations and experiments he records appear to establish the fact that considerably polluted river-water can be purified, on a large scale, to a satisfactory standard of safety. This finding is of prime importance, for, as the writer sets out, rivers are likely to be used to an increasing extent as sources of water-supply, seeing that other available sources of supply are limited, and that there is a considerable economy in the selection of river-water.

The subject-matter of the first three chapters

of this work formed three lectures which were recently delivered at the Royal Institute of Public Health, and the fourth chapter is upon the subject of sterilisation. This term is restricted in its application to the destruction of microbes causing epidemic water-borne disease; and the methods set out embrace the "excess lime" treatment (which is Dr. Houston's own suggestion) and the "chlorination" of water.

Some persons may consider that Dr. Houston takes too sanguine a view with regard to the safety of rivers as sources of water-supply. There can be no doubt, however, that the large amount of experimental work he has undertaken, notably that which illustrates the prime value of storage as a means of reducing the risk of water-borne disease, justifies his sanguine views. After all, where London has succeeded other towns can also succeed, always provided that in these other towns the same careful working is maintained by a well-trained *personnel* as is the case with London, and that a similar constant and scientific control of the state of the water is maintained. The danger is that these provisions may not always be made.

The American Indians North of Mexico. By W. H. Miner. Pp. x+169. (Cambridge: At the University Press, 1917.) Price 3*s.* net.

The literature connected with the North American Indians is so extensive that a readable summary of it in a popular form was much needed for the use of European anthropologists commencing the study. In America, particularly among the descendants of the hardy frontier men, the question is attracting increased attention. This want is well supplied in this book. The advanced student will depend not only on the classical works of Bancroft, Schoolcraft, and Catlin, but also on the monographs published by the Bureau of American Ethnology and other societies which have been summarised, with the addition of much new matter, by Mr. F. W. Hodge in his excellent "Handbook of American Indians North of Mexico." The questions connected with the origin of these tribes still form the subject of controversy. The writer remarks that the general consensus of opinion during the last century is to the effect that, "with the exception of the Eskimo, the natives of America are wholly of one race and descendants from early emigrants from north-eastern Asia, and especially of Mongolian stock." But the movements of these people within the American continent have as yet not been definitely settled. The importance of linguistics for the settlement of these problems is fully recognised. The book, after a summary account of the environment, discusses the sociology of the tribes, and gives details of some members of the Plains Indians and those of the south-west. The culture of the Pueblos forms the subject of an interesting chapter. There is a good bibliography, and the book may be commended as a satisfactory popular introduction to the study of a remarkable people.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Origin of Flint.

May I ask you to publish the following notes on the origin of flint? I understand that a discussion of the subject has been initiated by those interested in the chemical and physical aspects of geology, and think that the facts cited below may be of interest at this moment.

I understand by the term "the origin of flint" an account or reasonable explanation of the formation of the nodules of black flint which occur so abundantly in stratified layers in the Upper Chalk of this country.

Some seventy years ago the view was put forward by the well-known naturalist Bowerbank—who was a special student of the sponges—that the flint nodules of the chalk were formed *in situ* in the depths of the sea by the silicification of sponges which already contained abundant siliceous spicules, and were, as it were, solidified by attracting to themselves additional silica from the sea-water. Silicification of wood—as in the case of some wooden piers erected in shallow seas—was known. The segregation of silica by the attraction for it of organic matter was a recognised fact. Similar segregation and formation of "concretions" of other chemical substances by other attractive nuclei was recognised. Thus lumps or small masses of clay were shown to have the power of attracting phosphate of lime, and so to give rise to those "phosphatic" nodules found at the base of the Red and Coralline Crag, and also at the base of the Cambridge Greensand, and in other positions where the bones of animals were accumulated and furnished phosphate of lime, which was first dissolved by the sea-water and then removed from it and held by the clay nodules.

From time to time other views were put forward as to the formation of the flint-nodules of the chalk *after* the deposit of the chalk yet whilst it was still beneath the sea and permeated by sea-water. It was held that the organic remains deposited in strata in the chalk sea-bottom exercised an attractive influence on the silica dissolved in sea-water, and so led to the replacement of the organic remains by solid silica. Later it became fairly certain that, as is the case with the Atlantic ooze, the chalk deposit contained originally about 10 per cent. of colloid silica in the form of spicules and skeletons of minute organisms, and it was held that this silica was dissolved by the permeating sea-water (whilst the chalk was still beneath the sea), and was then separated and deposited in the cavities occupied by sponges and other organic remains in stratified layers in the chalk.

It is difficult enough to find a parallel for this supposed deposit when the solid, fairly (though not completely) homogeneous character of the black chalk flint is borne in mind. It is remarkable that the flint deposited in these cavities shows little or no trace of onion-like concentric layering, such as characterises the agates formed in geodes of igneous rock. We also are met with a striking fact, namely, that the black flint is apparently micro-crystalline in structure, and that its behaviour when "weathered" is such as to lead to the inference that, although homogeneous to the unaided eye, it yet consists of minute particles of quartz (that is to say, crystalline silica of the same nature as rock-crystal) *cemented by colloid silica*, which latter dissolves to a certain extent in alkaline

water containing CO_2 in solution, and thus gives rise to the white crust of "decomposed" flint which forms the outer "cortex" of all chalk flints.

(1) A fact of capital importance, which must affect any theory as to the origin of flint, is that in many localities where a chalk escarpment can be studied it is found that extensive fissures traverse the stratified layers of chalk and flint nodules at a sharp angle, and are filled with a continuous sheet of black, tabular flint. Such fissures may be seen in the cliffs at Rottingdean, near Brighton, often cutting through a thickness of 40 ft. or 50 ft. of the stratified chalk obliquely to the plane of the strata, and from these fissures sheets of flint 3 ft. square and ½ in. to 1 in. in thickness can be readily removed. The size of these sheets of flint *in situ* is apparently limited merely by the vertical height and inward extension of the fissure. The occurrence of these deep and extensive fissures—mere cracks in so far as their width is concerned—filled with a continuous deposit of black flint, makes it certain that the flint was deposited *after* the fissuring of the chalk, and therefore, almost certainly, after the elevation of the chalk, and probably through the operation of fresh-water of atmospheric origin penetrating the porous mass of chalk after its elevation. It is improbable that the nodules of flint in the chalk have an origin different from that of the "tabular" flint of the fissures. I am not able myself to bring forward any parallel case of the filling of extensive cavities and fissures in a sedimentary rock by a dense chemical deposit. The formation of "septaria" in clay is a parallel on a very small scale. The student of mineral veins and deposits may perhaps be able to throw some light on the matter.

(2) A further fact of importance to any theory of the origin of flint is that the black colour of flint—yellowish- or greenish-brown in thin splinters—is probably due to carbon, though no explanation has been offered of the *uniform* association of this element with flint. The existence in the Upper Chalk of oblong cylindrical nodules of *perfectly colourless* transparent quartz, occasionally showing blue or orange-brown patches or "floating clouds" scattered in the clear colourless silica, is also well known. A fine collection of these has been bequeathed to the Woodwardian Museum, Cambridge, by the Rev. Marmaduke Langdale. They are deposited in cavities once occupied by peculiar sponges (Choanites and Ventriculites). But why they are free from carbon—if carbon is the cause of the black colour of black flint—is not explained.

In the spring of 1916 a combustion analysis of black flint was made in the laboratory of the Royal Institution at my request, under Sir James Dewar's direction. The result pointed to the presence of minute quantities of carbon in the flint. But a very remarkable result was also obtained which it is necessary to re-examine by employing black flint from various localities in such combustions. A definite quantity of *arsenic* was deposited in the combustion tube in the form of the well-known arsenical mirror. Care was taken to check this startling result by exclusion of the possibility of *accidental* impurity in the material used. But I have not been able myself to pursue the matter further, and mention it now under all reserve, in the hope that some expert chemist will inquire into the subject. I am afraid that Sir James Dewar, to whose kindness I owe this initial examination of the chemical constituents of black flint, will not be able to give the necessary time to it.

I may add that another matter inquired into at my suggestion was as to the amount of *removable* water present in normal chalk flint as quarried, and the percentage of its own weight of water, which carefully dried black flint can absorb, and the rate at which the water is absorbed; further, the variation in these amounts caused by variation of temperature, and the question as to whether a sudden raising or lowering of temperature causes the fracture of *wet* flint *more readily* than of *dry* flint. Experiments were also made as to the form of fracture caused by thermal changes in flint, with the view of determining whether the conchoidal fracture can be produced in flint by thermal change alone, without the previous creation of structural strain by a blow. Although I am not able to report the results of these experiments, I wish to bring the desirability of a thorough chemical and physical examination of black flint to the notice of others who may have facilities for carrying through such an examination which I do not possess. I trust that some such fortunate experimentalist will take up the chemical and physical investigation of flint, without delay, as a serious task. It will take perhaps years to complete, but will yield results of the highest value to geology and to other branches of science.

The occurrence of arsenic in chalk flints may be due to its presence in minute quantities in sponges, the peculiar smell of which in the living state is suggestive of the presence of an organic compound similar to the strongly odorous gas known as diethylarsine.

May 25. E. RAY LANKESTER.

Plated Teeth of Sheep.

THE subject of Mr. Beeby Thompson's letter (NATURE, May 31, p. 264) has been noted in various parts of Great Britain. Writing in 1684, Andrew Symson, minister of Kirkinner, records in his "Large Description of Galloway" that "in this parish [Glasserton] there is a hill called the Fell of Barullion, and I have been told, but I give not much faith to it, that the sheep that feed there have commonly yellow teeth, as if they were guilded."

In this matter the worthy minister was unduly sceptical. The Fell of Barhullion is on my property, and jaws of sheep fed thereon have been brought to me with the teeth thickly plated with iron pyrites. The rock of the district is Lower Silurian; in the softer parts (Moffat Shales) large nodules of iron pyrites are found. As there is wet peaty soil on parts of the fell there is no lack of humic acid.

HERBERT MAXWELL.

Monreith, June 2.

The Stability of Lead Isotopes from Thorium.

PROF. SODDY'S view (NATURE, May 24, p. 244) involves the disappearance from the 20 kilos of thorite (with which he worked) of some 150 grams of unstable lead and its conversion into (probably) thallium. There should be present in the thorite thallium to the amount of about 0·012 gram per gram of thorium.

Such a quantity should be easily measurable. If found to be present, support would be given to Prof. Soddy's suggestion. We are told that the thallium was present in amounts "that sufficed for chemical as well as spectroscopic identification."

There is some difficulty in understanding how two-thirds the ionisation of a ray, additional to the seven α rays which go to generate the thorium halo, can have left no trace upon the halo. But the range may have been such as to render this possible. It is improbable, however, that a further α-ray transformation of thallium can have occurred without affecting the ionisation curve to an extent which would be detectable when the halo is compared with the curve as determined from the seven known rays.

J. JOLY.

Trinity College, Dublin, May 29.

ANALYSIS OF THE MECHANISM OF SPEECH.

THE impetus which recent events have given to the study of spoken languages has brought with it a renewed interest in the scientific analysis of the mechanism of speech. He who wishes to learn how to speak a foreign language must necessarily devote much of his time to the acquisition of the pronunciation, and he will most easily learn to become proficient at this difficult art if he can ascertain precisely what he has to do with his speech-organs in order to speak correctly. The need for accurate information about speech movements has led to the development of that branch

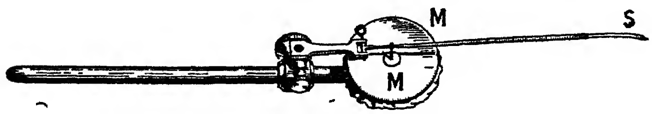

FIG. 1.—A Marey tambour. MM, the membrane; S, the style

of science known as experimental phonetics—the branch of science which has for its object the accurate analysis of speech by mechanical means.

Among the numerous instruments which have been devised for speech analysis there is one of particular importance, known as the phonetic kymograph, and it is the object of this article to give a brief description of the nature and use of this apparatus.

The phonetic kymograph is essentially an application of the Marey tambour to linguistic purposes. The principle of this tambour is well known, and it is not necessary to describe it in detail. It will be sufficient to recall that it is a

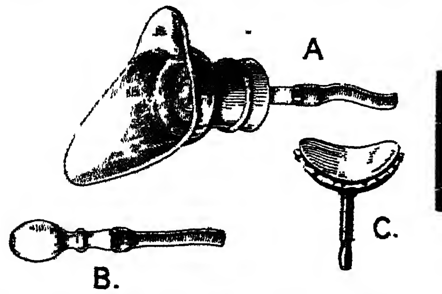

FIG. 2.—A, mouthpiece, B, nasal olive, C, larynx capsule.

mechanism by which vibrating air is communicated to an elastic membrane, and the vibrations of this membrane are in turn communicated to a very light needle or style (Fig. 1). The vibrations of the style are generally recorded on a revolving drum covered with smoked paper or some similar contrivance. Tambours may be of various sizes and materials. A very useful type is one in which the membrane is made of perished rubber, and measures 3 cm. in diameter.

Air vibrations set up by speech may be communicated to the tambour in three principal ways: (1) from the mouth, (2) from the nose, (3) from the outside of the larynx. A rubber tube is attached to the tambour, and at the end of this tube is fitted (A) a mouthpiece (into which the observer speaks), or (B) a nasal olive (which fits into one nostril), or (C) a "larynx capsule" (which is pressed firmly against the outside of the larynx). These appliances are shown in Fig. 2.

The complete apparatus is shown in Fig. 3, which is an illustration of a small portable kymograph. The diagrams in this article were made on the large kymograph in the laboratory of ex-

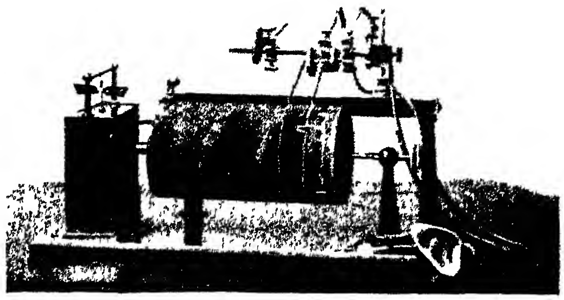

FIG. 3.—A small portable kymograph

perimental phonetics at University College, London; the cylinder of this machine has a circumference of one metre and a maximum surface speed of 70 cm. per second.

The most useful single tracings that can be made on the phonetic kymograph are those which result from speaking into the mouthpiece. More detailed information may, however, often be obtained by taking nose and mouth tracings, or mouth and larynx tracings simultaneously, or by taking tracings of all three kinds at the same time.

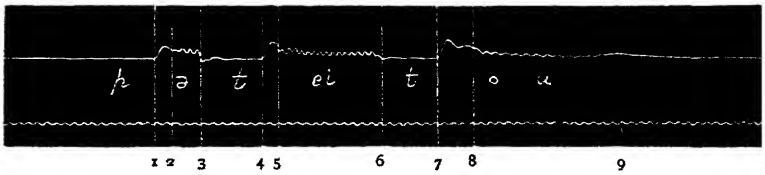

FIG. 4.—Mouth-tracing of *potato*.

The accompanying illustrations show the nature of kymographic tracings and the deductions which can be made from them. Fig. 4 shows a mouth-tracing of the English word *potato*.[1] The horizontal parts of the line show the places where no air issues from the mouth, *i.e.* the "stops" of the consonants *p*, *t*, and *t*. The three steep rises in the line mark the plosions of these consonants. The small waves are caused by the air set in vibration by the vocal chords when "voice" is produced; in this diagram they represent the vowels. The regular wavy line figuring in this and other illustrations is a time-measurer showing hundredths of a second.

Various features of pronunciation may be

[1] The lettering appearing in this and other diagrams is a phonetic transcription of the pronunciation (International Phonetic system).

studied from such a tracing as this. Such are: (1) the extent of "aspiration" of the plosive consonants (shown by the distances between the vertical lines 1 and 2, 4 and 5, 7 and 8); (2) the lengths of the vowels (shown by the distances between the vertical lines 2 and 3, 5 and 6, 8 and 9). The variations in the pitch of the voice may also be calculated to any degree of accuracy by measuring the voice vibrations in successive small intervals.

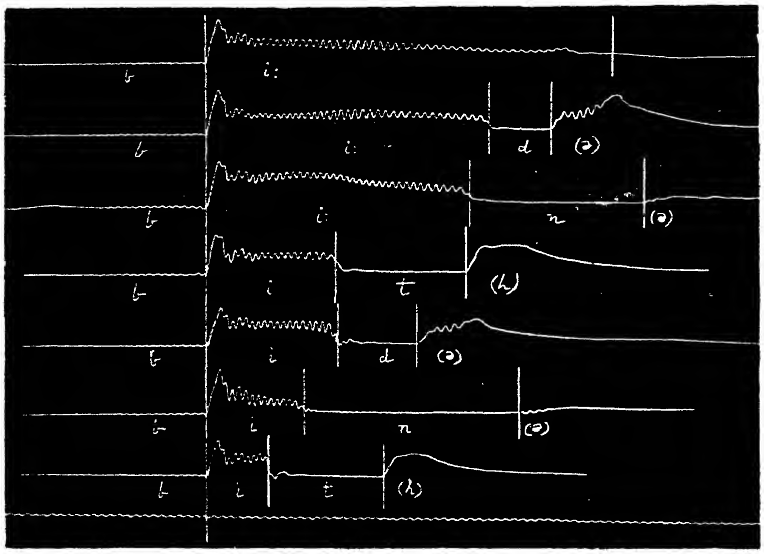

FIG. 5.—Mouth-tracings of *bee, bead, bean, beat, bid, bin, bit*, showing lengths of vowels and final consonants.

Fig. 5 illustrates the variations in length which English vowels undergo under certain conditions. The first four tracings show variations in the length of the English sound of *ee* as exhibited in the words *bee, bead, bean, beat,* and the remaining three tracings show similar variations in the length of the so-called "short *i*" in the words *bid, bin, bit.* It will be seen that the vowels in *bean* and *beat* differ from that in *bead* in somewhat the same manner as the vowels in *bin* and *bit* differ from that in *bid.* It will also be observed that the so-called "short" vowel in *bid* is just about the same length as the so-called "long" vowel in *beat.* (Ignorance of the fact that the vowels in words like *beat, late,* are much shorter than those in *bead, laid,* is the cause of noticeable mispronunciation on the part of many foreigners.)

Fig. 6 shows (A) a mouth-tracing of the word *play* said by the writer, (B) a mouth-tracing of the same word said by a Flemish-speaking Belgian with a bad accent. It will be noticed that the Belgian mispronounced the *l* by making it completely voiced; in normal English this *l* is partially devocalised, *i.e.* the vibration of the vocal chords does not begin until an appreciable time after the explosion of the *p.*

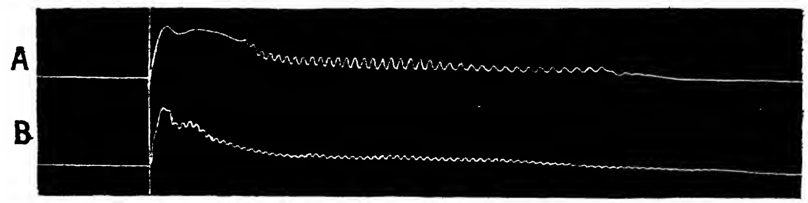

FIG. 6.—A, mouth tracing of *play* as said by the writer, B, mouth-tracing of the same word mispronounced by a Flemish-speaking Belgian

Fig. 7 is a record of *good morning* (as said on parting), in which tracings of the nose, mouth, larynx, and a time-measurer have been taken simultaneously. The points at which the various sounds begin and end are clearly seen from the nose and mouth tracings. (This is where kymographic tracings have an advantage over enlargements of talking-machine records.) The distances between the vertical lines show the lengths of the various sounds. From the nose-tracings we may gather information as to the extent to which nasal consonants exert a nasalising influence on neighbouring vowels. The larynx-tracing shows vibration-waves throughout, since every sound is voiced; this would be the most convenient curve to use for the purpose of calculating pitch.

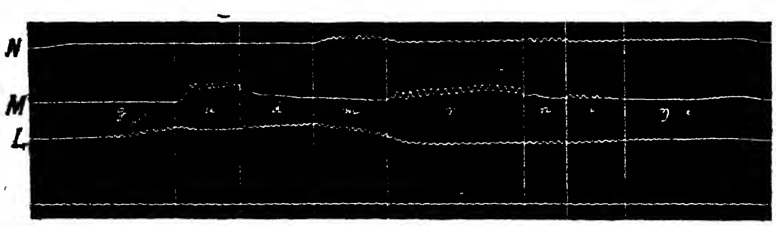

FIG. 7.—Simultaneous nose, mouth, and larynx tracings of *good morning* (as said on parting)

Fig. 8 shows mouth-tracings of the English *buckle* and the French *boucle.* Two important differences will be noticed in regard to the consonants: (A) the English *l* is voiced, whereas the French *l* is not; (B) in the French word the *k*-sound is held on about twice as long as it is in the English word. The smallness of the voice-waves in the French

word is due to the fact that the record is of a lady's voice.

The above short account of the phonetic kymograph will give some idea of the scope of the apparatus. It will be seen that the instrument is

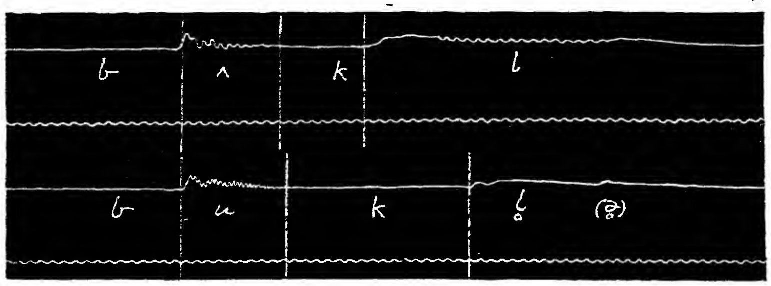

FIG. 8.—A, mouth-tracing of English *buckle* (male voice); B, mouth-tracing of French *boucle* (female voice).

chiefly useful (1) for detecting the presence or absence of voice, (2) for detecting the presence or absence of nasality, (3) for measuring the lengths of sounds, and (4) for calculating the pitch of the voice.

DANIEL JONES.

A UNIVERSITY DEGREE IN HORTICULTURE.

THE University of London has, at the suggestion of the council of the Royal Horticultural Society, established a B.Sc. degree in Horticulture. Syllabuses for internal and external students have been drafted, and the University has under consideration the recognition of the Royal Horticultural Society's school and research station at Wisley as a school of the University.

There can be no question that, if university degrees are to be given in technical subjects, the case for a degree in horticulture is a good one; for horticulture connotes not only an industry and an art, but also an applied science.

First of all, however, it is a craft, and, like all crafts, it depends for its successful pursuit on the exercise of practical skill. Therefore, an academic recognition of proficiency which does not carry with it a sure indication of craftsmanship is not only useless, but also pernicious.

The proposed degree in horticulture, if the spirit of the regulations which govern it is observed, makes adequate provision for the requirement of technical expertness. A candidate for the internal degree, besides matriculating and passing the Intermediate Science Examination, must pass the Preliminary Examination for the National Diploma in Horticulture before he proceeds to the Final Examination. This examination, established by the Royal Horticultural Society with the approval of the Board of Agriculture, is an adequate elementary test of practical knowledge and ability. Furthermore, during the final course candidates are required to perfect their knowledge of practical horticulture, and the sciences which are prescribed in the course of study are to be taught with definite reference to horticulture.

If, therefore, a student follows this course at a horticultural college, there is but little danger that general science, botany and chemistry and entomology, will divert unduly the student's interest from horticulture. The Bachelor of Science in Horticulture would thus be possessed of a fair knowledge of science, and would also be a proficient practical horticulturist, able to dig and trench, plant and prune, bud and graft at best as well as the average gardener. If this prove, in fact, to be the case, both science and horticulture will gain. For at present there is a deep gulf fixed between the science and practice of horticulture. The well-trained man of science, say the Part II. Tripos man, has become too specialised in habits of work, too much a victim of the laboratory habit, to be willing to spend a year or so working with his hands on the land.

For these reasons it may be hoped that the establishment of a degree in horticulture will be of no less benefit to potential botanists and agricultural chemists than to professional horticulturists. In the case of botany, at all events, it may reasonably be asserted that much of the botanical ritual observed in our university laboratories is outworn; and although we are not confusing botanists with gardeners, we are confident that, if botanical students were to spend half as many hours working in the garden as they now spend with microscopes and microtomes, they would become better botanists.

From yet another point of view the degree in horticulture is to be welcomed. Tropical horticulture is in many cases more akin to horticulture than to the agriculture practised in this country. The Empire has great need of men to aid in developing its resources. The old class of administrator—the man who could administer anything about which he knew nothing—has been found out. The war has weighed him in the balances and proved him wanting. The new class of administrator must be a new kind of practical man—"a hewer, not a heaver, of things." By providing a course of training in the practice and science of horticulture, the University of London has made a contribution towards meeting the need for this new class of practical men.

This will only be the case, however, if the University insists upon satisfactory practical training for all candidates for degrees in horticulture, and not from internal students only. Unfortunately, the regulations for the external degree in horticulture provide for no *training* in practical horticulture, nor, to be fair, does it

provide for *training* in anything else. This omission can satisfy only those who believe that ability to pass an examination is sufficient evidence of training. External students are required to pass an examination in practical horticulture. The test lasts one day only, whereas not fewer than two days, and preferably three, should be spent by the student in demonstrating his skill in practical horticulture. Unless the examination is so arranged as to secure that every recipient of the degree has a sound knowledge of practical horticulture, the establishment of a degree in this subject will do more harm than good.

CONTINUATIVE EDUCATION IN FRANCE.

ENGLAND is not the only Allied country that is thinking of putting its educational house in order, even before the end of the war. Our good neighbour France is engaged on a similar project. Thanks to the kindness of M. Maurice Roger, one of the leading specialists on technical education in France, the present writer is able to give a brief account of the French proposals, which, in the light of Mr. Fisher's somewhat tantalising treatment of the subject, cannot fail greatly to interest the English public.

The Bill before the French Chamber is essentially a consolidating measure, while at the same time it introduces the principle of compulsion, the attempt at voluntary continuative education having failed to produce adequate results. Hitherto commercial and technical education have formed the subject of one law, agricultural of another, and physical training of a third. All three laws have passed one or other of the two Chambers. The new proposals will co-ordinate the three laws in one in order that the education of the future student may be similarly co-ordinated.

The aim of the education will be alike economic and civic, and the physical education will, in the case of the male student, lead up to military training. The unskilled, as well as the skilled, employee must attend these schools, which are not to be schools for workmen, but schools where workmen, especially the unskilled, may increase their economic productivity. It is significant to note that, in spite of the centralising traditions of French education, the classes are to be organised in accordance with local or regional needs, under the guidance of local committees for each commune. When the commune is a large town like Paris or Marseilles, the unit chosen seems very suitable, but in the case of the small village it is certainly not large enough. Such committees are to be composed of town and district councillors, doctors, official members, representatives of chambers of commerce and agricultural societies (very strong and influential bodies in certain parts of France), and delegates from associations of employers and trade-unions and various other important local societies. Above them will be a county council committee, and at the top a central committee to exercise a general oversight and control. Two stages of study are mapped out; the first is up to seventeen for boys and sixteen for girls.

Curiously enough, the recent English Departmental Committee on Juvenile Education in relation to Employment after the War also recommended two stages, but the first in the English proposals extends only to sixteen years of age. In this first period in the French scheme the obligatory subjects are French, history and geography, physical exercises, science applied to agriculture, industry, commerce, and navigation, or domestic economy, comprising practical work in each case. A minimum of fifty hours is assigned to general education, 150 to professional, and 100 to physical, the last being allotted to Sunday. This makes 300 hours, as against 320 suggested by the English committee, which proposes a minimum of only about fifty hours a week for physical exercises.

The second stage is from seventeen to twenty years of age for young men and sixteen to eighteen for girls, compared with sixteen to eighteen for English students. French, conferences on history, geography, civics, common law, and political economy are assigned a minimum of 100 hours, and the same amount is to be devoted to gymnastics and the preparation for military service. For girls the place of the latter is taken by manual work, hygiene, and some notions of medicine and child-rearing.

Existing technical, commercial, and higher elementary school buildings are to be utilised so far as possible for giving continuative education. The more technical subjects will be taught by professional teachers, but elementary-school teachers will be largely used for the more general parts of the course. To enable them to give the extra time out of school, the ordinary day-school hours will be shortened by half an hour, and the summer holidays increased to two months. If more than 200 teaching hours of continuative education are required of them they are to receive extra pay. It is very significant to note that private schools will be allowed, under certain conditions, to provide continuative education.

CLOUDESLEY BRERETON.

NOTES.

THE list of honours conferred on the occasion of the celebration of the King's birthday on June 3 includes the following names of men known in scientific circles:—*Baronets:* Sir Thomas Elliott, Deputy-Master and Comptroller of the Mint (retiring); Sir Robert Hadfield, F.R.S., past-president of the Iron and Steel Institute and of the Faraday Society; Mr. James Knott, formerly president of the Institute of Marine Engineers; Sir Philip Magnus, representative in Parliament for the University of London since 1906; the Right Hon. T. W. Russell, Vice-President of the Department of Agriculture and Technical Instruction for Ireland; Dr. Frederick Taylor, president of the Royal College of Physicians. *Knights:* Prof. W. J. Ashley, professor and dean of the faculty of commerce at Birming-

ham University; Mr. Graham Balfour, secretary to the Staffordshire Education Committee; Mr. F. H. Barker, for his work in the development and adoption of the Parsons steam turbine throughout the principal countries of Europe; Prof. T. Kennedy Dalziel, professor of surgery, Anderson's College, Glasgow; Dr. T. Gregory Foster, the provost of University College, London; Dr. R T. Glazebrook, F.R.S., director of the National Physical Laboratory since 1899; Mr. Robert Jones, lecturer on orthopædic surgery, Liverpool University, and inspector of military orthopædics, A.M.C.; Mr. William Peck, director of the City Observatory, Calton Hill, Edinburgh; Prof. E. C. Stirling, professor of physiology in the University of Adelaide; Mr. H. F. Waterhouse, dean and lecturer on anatomy at Charing Cross Medical School. *K.C.B.:* Dr H. F. Heath, secretary of the Department of Scientific and Industrial Research. *K.C.M.G.:* Dr. R. A. Falconer, president of the University of Toronto. *C.M.G.:* Mr. R. C. Allen, Director of Surveys and Land Officer, Uganda Protectorate; Mr. T. Hood, Director of the Medical and Sanitary Service, Nigeria; Mr. F. E. Kanthack, Director of Irrigation, Union of South Africa. *C.I.E.:* Lt.-Col. D. W. Sutherland, principal, and professor of medicine, Medical College and School, Lahore, Punjab; Mr. Taw Sein Ko, superintendent, Archæological Survey, Burma. *Kaisar-i-Hind Medal:* Capt. R. H. Bott, professor of surgery, Medical College, Lahore, Punjab.

We regret to announce the death, on June 2, of Dr. W. H. Besant, F.R.S., fellow of St. John's College, Cambridge, in his eighty-ninth year.

We notice with regret the announcement of the death on May 29, at seventy-five years of age, of Sir William D. Niven, K.C.B., F.R.S., late director of studies, Royal Naval College, Greenwich.

According to the *Electrician* it is proposed to change the name of the Canadian Society of Engineers to the Canadian Institution of Engineers, and to enlarge the scope of the society by the admission of electrical, chemical, mining, and mechanical engineers.

Mr. Stephen Paget is collecting notes for a book on the life and work of the late Sir Victor Horsley, and he asks friends, colleagues, and patients of Horsley to send him any letters which may be used for the purposes of the book. Great care will be taken to return all letters, which should be sent to Mr. Paget at 21 Ladbroke Square, W.11.

Mr. J. Ramsbottom, of the Department of Botany, British Museum, has been appointed protozoologist to the medical staff at Salonika. The trustees of the museum have accepted Miss Lorrain Smith's offer to act as temporary assistant in charge of the fungi during Mr. Ramsbottom's absence and to deal with inquiries relating to this group of plants. Miss Lorrain Smith has been associated with the department for many years, especially in connection with the revision and completion of Crombie's "Monograph of British Lichens," the second volume of which (by Miss Smith) appeared in 1911; the second edition of vol i., which will bring the whole work up to date, is now almost complete.

A paragraph has appeared generally in the daily Press relating to a new and wonderful explosive of American origin "so powerful that five grains, its inventor claims, would blow the largest building in the world to pieces." One must conclude that the accident which led to the discovery yielded only minute quantities, or the United States might have been disintegrated! Sensational statements of this description may appeal to the public imagination, but it must be remembered that some of the most highly explosive substances are inapplicable by reason of the difficulties and risks of manufacture, of their sensitiveness, and of our inability to control the explosion. If the new "Terrorall" is even one-thousandth as powerful as stated it by no means follows that it will prove of service in the war.

At the aniversary meeting of the Linnean Society on May 24 the following were elected officers and council for the ensuing year:—*President:* Sir David Prain. *Treasurer:* Horace W. Monckton. *Secretaries:* Dr. B. Daydon Jackson, E. S. Goodrich, and Dr. A. B. Rendle. *Council* (in addition to these officers): Mrs. Agnes Arber; E. G. Baker; Prof. W. Bateson; E. T. Browne; R. H. Burne; Sir Frank Crisp, Bart.; A. D. Cotton; J. Groves; Miss G. Lister; Gerald Loder; Prof. G. E. Nicholls; Prof. H. G. Plimmer; Dr. D. H. Scott; Dr. A. E. Shipley; and Lt.-Col. J. H. T. Walsh. The president handed to Mr. T. G. White, secretary of the Agent-General for New South Wales, the Crisp award and medal to be forwarded to Dr. Robin John Tillyard, of Sydney University; and presented to Mr. H. B. Guppy the Linnean gold medal awarded to him for his services to biology.

In a recent note (Nature, May 24, p. 250) we directed attention to the renewed audibility in the south-eastern counties of the gun-firing on the Western front. We have received another account from Dr. H. S. Allen, who, from the porch on the south side of Cressington Church, Surrey, heard very distant gun-firing at 11.30 a.m. on May 28. "The church is two miles south of Surbiton, and stands on a slight eminence from which an uninterrupted view of the North Downs is obtained. There were light, variable breezes from the south-east. The reports followed one another at irregular intervals, but the average time between successive reports was about three seconds." According to Sir Douglas Haig's report, there was "considerable artillery activity on both sides during the day south of the Scarpe and in the Ypres sector."

By direction of the War Cabinet, Dr. Addison, the Minister of Munitions, has made arrangements for the appointment of an interdepartmental committee to prepare a scheme for the establishment in London of an Imperial Mineral Resources Bureau:—(*a*) To collect information in regard to the mineral resources and metal requirements of the Empire, and (*b*) to advise what action, if any, may appear desirable to enable such resources to be developed and made available to meet requirements. The members of the committee are as follows:—Sir James Stevenson, Bt. (chairman), Mr. C. L. Budd, Sir A. Duckham, Prof. W. R. Dunstan, Mr. C. W. Fielding, Mr. J. F. N. Green, Rt. Hon. Lord Islington, Mr. L. J. Kershaw, Sir T. Mackenzie, Hon. Sir G. H. Perley, Mr. W. S. Robinson, and Rt. Hon. W. P. Schreiner. The secretary to the committee is Mr. Oswald C. Allen, and all communications on the subject should be addressed to him at the Ministry of Munitions, Whitehall Place, S.W.1.

Under the title, "Rhubarb and Red Tape," the *British Medical Journal* for June 2 makes the following remarks upon the suspension of the *Kew Bulletin*:—"Our contemporary, Nature, published on May 24 an interesting and timely article on rhubarb, intended by its author for the *Kew Bulletin*, the publication of which the Government in its wisdom has decided to suspend. The official explanation given,

for this paltry piece of economy is that 'it has been ruled that the *Kew Bulletin* is not essential, and its publication has therefore been suspended' owing to the shortage of paper. The small amount of paper needed to secure the continued publication of so useful a periodical, which serves as a link between scientific and economic botany, could well be spared by a trifling reduction in the waste of paper in a single Government department. Lop-sided actions of this sort bring our Government into contempt, and indicate a narrowness of outlook threatening the future of the country."

SIR ERNEST SHACKLETON has returned to this country after lecturing in Australia and America on his return from the Antarctic. In a brief interview he gave to Reuter's Agency Sir Ernest said that much scientific work had been done despite the disaster to the expedition and the failure of the plan to cross Antarctica. He confirms the opinion held by all who know the Weddell Sea that it is the worst sea in the world for ice congestion and pressure. The most interesting statement he made, however, was with regard to Morrell Land, or New South Greenland, which is supposed to project northward from Antarctica into the Weddell Sea. Since Morrell, in 1823, sighted part of the coastline of this land no voyager has definitely seen it, but, on the other hand, no one has been able to sail over its supposed position, while circumstantial evidence is strongly in its favour. Sir Ernest claims to have sailed over and so proved its non-existence. It would be most interesting to have further details, with latitude and longitudes, so that this problem can be definitely cleared up. Morrell may have been a little wrong in his longitudes, but it will be surprising if no land exists in the western part of the Weddell Sea.

THE letter on "Plated Teeth of Sheep," published in NATURE of May 31, has brought us a copy of a paper "On So-called Gold-coated Teeth in Sheep," by Prof. A. Liversidge, formerly professor of chemistry, University of Sydney, read before the Royal Society of New South Wales on June 7, 1905. Prof. Liversidge received the lower half of a sheep's jawbone, the teeth of which were more or less completely encrusted with a yellow, metallic-looking substance, but more like iron pyrites (marcasite) or brass than gold. He found that the incrustation readily came off in scales when even lightly scratched with the point of a penknife. The surface of the tooth under the scale was found to be black, but apparently not decayed; the thickness of the deposit was apparently less than 1 mm. The scale partly dissolved in dilute acid. The residue consisted of filmy organic matter, still possessing a metallic sheen, although white in colour instead of yellow. When heated on platinum foil the scale blackened, partly fused, and left a white residue soluble in dilute hydrochloric or nitric acid. The residue contained phosphoric acid. and apparently consisted mainly of calcium phosphate. Under the microscope the scale was seen to be translucent and of a pale brownish colour, and under a $\frac{1}{6}$-in. objective it was seen to be made of thin layers, but with no recognisable organic structure. Prof. Liversidge concluded that "the metallic lustre is due to the way in which the light is reflected from the surfaces of the superimposed films. The incrustation on the teeth is apparently a deposit of tartar, and perhaps partly due to superficial decay of the tooth."

THE Royal Academy of Sciences and Letters of Denmark has announced the subjects on which it invites memoirs, with a view to the award of its medals and prizes. The subject in history, for which the prize is the academy's gold medal, is the origin and development of alchemy among the Greeks, based on the examination of Greek literature. In astronomy the society's gold medal will be awarded to the approved memoir on the distances of stars of spectral class N (Secchi's Type IV.), their distribution in space, and the determination of their velocities. For the academy's gold medal in physics the subject is an experimental research on the transparency and electrical conductivity of thin metallic films, special importance being attached to the determination of the thickness of such films. The prize of 800 crowns arising out of the Classen legacy is offered for the approved memoir on the light thrown on the habitats and the immigration into Denmark of weeds, especially those of cultivated areas, by palæontology and history, and by the study of the various means and routes of the migration of these plants. In all these cases memoirs must be sent in by October 31, 1918. The prize of 800 crowns derived from the Thott legacy is to be awarded in connection with a subject announced in 1914, namely, a description based on existing literature, as well as on personal research work, of the facts which ought to be taken into account in drying seeds, special attention being given to the kinds of direct interest to Danish agriculture. These memoirs are to be sent in by October 31 next. The essays may be written in any one of seven specified languages, including English, and are to be sent to Prof. H. G. Zeuthen, secretary of the Academy.

A STATUE of the eminent chemist, Prof. Marcelin Berthelot, sometime professor at the Paris School of Pharmacy, was unveiled in Paris on May 21. We reprint from the *Chemist and Druggist* the following interesting account of the ceremony given by its Paris correspondent:—"The Sorbonne, as the home of the faculty of sciences and the heart of the Latin Quarter, was appropriately chosen for the function, which marked the close of the Exhibition of 'School and War,' organised by the French Teaching League. The great amphitheatre was filled to suffocation, and on the platform were the representatives of official and intellectual France—M. Raymond Poincaré and his Ministers of State, the Paris Municipal Council, and the teaching staff of the University. The speakers were the head of the College of France (to which Berthelot was attached), the Prefect of the Seine, the President of the Municipal Council, the Director of the French Academy, the Vice-President of the Italian Senate, and others. There was a war-time note in many of the speeches. M. Armand Gautier, the chosen orator of the Academy of Sciences, told how during the 1870–71 siege of Paris he met Berthelot returning from a visit to the outposts, where he had accompanied a French general. The *savant* had shown the soldier how the defence of the city could be improved; the general had hesitated for fear of reprisals, not wishing to provoke the enemy to bombard Paris. Shortly after, the Latin Quarter was shelled, and the College of France and the Museum were damaged. M. Painlevé, Minister of War, referred to the same epoch. Not only did Berthelot show how chemical substances could be synthesised, but 'he dared to apply scientific methods to these explosives, the violence and terrible rapidity of which seemed to defy all control, but of which the artilleryman must understand the laws the better to regulate and subjugate.' It was 'his long and obstinate research into the problems of waves of explosion which led up to M. Vieille's discovery of smokeless powder.' The speeches terminated, the official *cortège* proceeded to the statue hard by—the work of M. René de Saint-Marceaux. When this was unveiled the Paris school children and the Cadet Corps—some thousands of

young people in all—marched past the monument of the *savant* and patriot."

THE importance of ethnobotany, a new field of research which, if investigated systematically, will yield results of great value both to the ethnologist and the botanist, is now fully recognised, particularly in America. The questions with which the ethnobotanist deals are: the primitive ideas and conceptions of plant life; the effects of a given plant environment on the lives, customs, religion, thoughts, and everyday practical affairs of the people studied; the use of plants for economic, magical, or ceremonial purposes; how far their knowledge of plant life extends; the study of plant names as a branch of the local folklore. The methods and results to be gained from this field of investigation are fully explained in Bulletin No. 55 of the American Bureau of Ethnology, entitled "Ethnobotany of the Tewa Indians," by Messrs. W. W. Robbins and J. P. Harrington and Miss Barbara Freire-Marreco, which supplies a useful introduction to this new field of research.

THE Journal of the Academy of Natural Sciences of Philadelphia, second series, vol. xvi., part iii., is devoted to a report, printed in a style which few societies in this country can rival, compiled by Mr. C. B. Moore, on some aboriginal sites on Green River, Kentucky, and on the Ohio and Mississippi. Some of these implements supplied curious objects made of deer's antlers, hooked at one end, and having a cavity in the other, in which fragments of asphalt were found, apparently intended to fix something introduced into the cavity. There is some doubt as to the object for which these articles were intended. Possibly the hooked implements were used as netting needles, while others of a different form were "sizers," used for spacing the meshes of the nets. The cavity may have held some decorative object. The full collection of photographs appended to this report will doubtless soon lead to a final settlement of the use of these implements.

Abstracts of Bacteriology is the title of a new publication issued bi-monthly under the editorial direction of the Society of American Bacteriologists, the first number appearing in February. The purpose is, as the name implies, to review current literature on bacteriology in all its various branches, and a journal of this kind will be very welcome now that German periodicals of a similar character are difficult to obtain and are tabooed by many. A list of periodicals to be reviewed is given, and comprises some 650 titles. We predict a cordial reception for this new aid to bacteriological research. The British publisher is the Cambridge University Press, Fetter Lane, London, E.C.4.

WE have received a copy of the May issue of the *Veterinary Review* (vol. i., No. 2), a new periodical devoted to veterinary science and practice. It contains a review of the present state of knowledge of specific polyarthritis, an infective disease of the joints attacking foals. The remainder of the issue is devoted to abstracts of publications, which seem to be well chosen and will be very useful, and to notes on books and a bibliography of veterinary publications (thirty-four pages). The *Veterinary Review,* which is edited by Dr. Charnock Bradley, is published quarterly by Messrs. W. Green and Son, Edinburgh, at an annual subscription of 10*s.* 6*d.*

THOUGH much has been written on the fur-seal of the Pribilof Islands, Prof. G. H. Parker, in the *Scientific Monthly* for May, has contrived, in a most admirable summary of the life-history of this animal, to add many new and important facts. Not only from the commercial, but also from the zoologist's point of view, it is fortunate that the largest existing herd of fur-seals is that which breeds on the Pribilof Islands, for these now belong to the United States, which came into possession of the islands with the purchase of Alaska from Russia in 1867. When in 1910 the lease to the North American Commercial Company expired, the Government abandoned the leasing system and took over the management of the herd to avert, if possible, the steady decline in its numbers. This decline was due, not to the regular killing on land, but to pelagic sealing resulting in the slaughter of from 60 to 80 per cent. of females, the pups of which, as a consequence, were left to starve. To save the herd pelagic sealing was forbidden, and later all killing on the islands was banned, except of such animals as were needed to furnish food for the natives until the end of the 1917 season. This, Prof. Parker considers, was a mistake, since it has encouraged the undue increase of "bachelors," which disturb the harems of the breeding bulls. These "bachelors," he contends, should be thinned by taking toll of three-year-old males, the skins being then at their prime. The average life of the fur-seal appears to be from twelve to fourteen years. But while the bulls do not begin to breed until they are six or seven years old, the females are sexually active for almost twice that period. Hence the advisability of reducing the number of "bachelors."

THE "Book of the Madras Exhibition, 1915–16," contains a report of a lecture by Mr. Jas. Hornell dealing, among other things, with the question of pearl culture in Indian seas. The author believes that a great natural pearl fishery must always be a rare and fortuitous occurrence. There will always be series of bad seasons, and now and then a successful one. The natural factors which produce these good and bad seasons are so powerful that man's interference seems to be unavailing, and further expenditure of money is regarded as useless. There are, however, very encouraging results with respect to the artificial culture of true pearls, and the production of induced pearls is already a growing industry in Japan. Small spherules of mother-of-pearl are carefully inserted between the mantle lobe and shell of the mother mollusc, and after a period of about two years a marketable pearl has been formed. This is, at best, only a three-quarter pearl, and the imperfect side must be completed by cementing on a convex flake of mother-of-pearl. Therefore the gem cannot be used as a unit for stringing, but it can be utilised wherever there is intricate mounting of some kind. Mr. Hornell refers to a process of his own whereby true pearls, absolutely flawless and spherical, can be produced. So far he has obtained pearls of microscopic size only, but this is due to the limited time of growth in the conditions of his experiments. Indian waters, he points out, are more suitable for such processes than Japanese waters, for in the former there is no winter pause of growth.

IN the *Journal of Agricultural Research* (vol. vii., No. 7) A. C. Baker and W. F. Turner give a full account of the rosy apple aphis (*A. malifoliae* or *A. sorbi*) in which some new facts of importance may be found. The authors confirm previous statements that plantain is the alternate host of the insect. Another common British aphid, *Macrosiphum granarium,* is described, with excellent figures, by W. J. Phillips in No. 11 of the same volume. This latter number contains also an account of *Syntomaspis druparum,* a

chalcid which, instead of adopting a parasitic mode of larval life, lays eggs in apple-seeds, within which the grubs feed. N. E. McIndoo discusses in No. 3 of the same volume the effects of nicotine as an insecticide. He finds that the spray solutions neither pass into the air-tubes nor penetrate the cuticle and skin, but the fumes traverse the air-tubes and are distributed to the tissues, killing insects by paralysis, due to structural changes in the nerve-cells.

At a meeting of the American Institute of Electrical Engineers in November last Prof. J. B. Whitehead, of Johns Hopkins University, gave an account of a new form of voltmeter he has developed for measuring potential differences up to 150 kilovolts. The complete paper appears in the April Journal of the Franklin Institute. The instrument depends on the constancy of the electric field at which the corona discharge is formed between a wire and a cylinder along the axis of which the wire is placed. In that reading to 100 kilovolts the wire is of nickel-plated tool steel 0·6 cm. diameter and about 150 cm. long. It is surrounded by a perforated cylindrical electrode 30 cm. diameter and 90 cm. long. Both wire and cylinder are enclosed in a cylindrical vessel in which the pressure of the air can be varied from 40 to 140 cm. of mercury. The potential at which the corona forms at the surface of the wire appears to be independent of the frequency when alternating currents are used, and to be uninfluenced by the presence of moisture in the air. It is a function of the radii of the wire and outer electrode, and of the pressure and temperature of the air. The formation of the corona is detected either by an electroscope or a galvanometer connected to the outer electrode, or by a telephone with its transmitter inside and its receiver outside the containing vessel.

The estimation of toluene in crude petroleum was the subject of a paper read before the Institution of Petroleum Technologists on May 15 by Mr. S. E. Bowrey. It is pointed out that, whilst the process of cracking increases the percentage of aromatics in the oil, there is a serious loss of oil by carbonisation. The experiments were therefore limited to the crude oil. After carefully examining the method of fractionation and of extraction by sulphonation and nitration, all of which possess serious disadvantages, Mr. Bowrey eventually adopted the method of extraction by liquid sulphur dioxide at low temperatures as affording the most satisfactory results. The process is carried out in the following manner:—The crude oil is first distilled and the distillate collected up to 150°. The latter is then freed from unsaturated hydrocarbons by shaking with 90 per cent. sulphuric acid, and afterwards with alkali and water. The purified spirit is then extracted with successive quantities of liquid sulphur dioxide at −35°, and the combined extract carefully fractionated with a special form of fractionating apparatus. In this way a series of fractions is obtained from which the percentage of benzene, toluene, and xylene can be estimated, and the quantities are further controlled by a specific gravity determination. Each of the steps described has been carefully tested by the use of artificially prepared mixtures of light petroleum and the three aromatic hydrocarbons, and the results, considering the difficulties of the problem, appear to be very satisfactory.

A short paper by Prof. K. C. Browning, of Colombo, on "The Detection of Traces of Mercury Salts for Toxological Purposes" (Journ. Chem. Soc., vol. cxi., p. 236) describes a process whereby the detection of this element can be carried to a point comparable with that reached in the case of arsenic. The method consists in depositing the mercury on a cathode of gold foil, and then vaporising it in a vacuum tube, where its presence is detected spectroscopically. Under these conditions one part of mercuric chloride in 1000 million parts of solution can be detected. Attempts to concentrate liquids containing minute traces of mercury are usually futile, on account of the volatility of the metal and its compounds; in such cases it is better to use a large volume of well-stirred liquid and rely exclusively upon electrolysis for concentration.

In the issue of the *Engineer* for May 18 there is an interesting account of the very important hydro-electric power supply undertaking for Bombay known as the Tatà power scheme, by which energy is supplied to Bombay over a distance of some forty-three miles. The source of the power is three artificial lakes, or reservoirs, in the Western Ghauts, known respectively as Lake Lonawla (986 acres), Lake Walwhan (1535 acres), and Lake Shirawta (3174 acres). They stand in order of elevation, commencing with the lowest, which exceeds 2000 ft. above sea-level, and they are capable jointly of storing sixty thousand million gallons of water. The district in which the "lakes" are situated is remarkable for its heavy rainfall. During monsoons the precipitation is extraordinary, as much as 546 in. ($45\frac{1}{2}$ ft.) having fallen in the catchment area during a single monsoon, of which quantity 440 in. ($36\frac{2}{3}$ ft.) fell within thirty-one consecutive days. The "lakes" have been formed by the construction of dams, which, though not of remarkable height, are certainly of unusual length. The shortest is 1900 ft. long, and the longest no fewer than 8000 ft.—just above $1\frac{1}{2}$ miles. All the dams are built of masonry, with coursed faces and rubble hearting. The Shirawta and Walwhan Lakes are connected by a tunnel in hard trap-rock, 5000 ft. in length. The waterways are designed for a water capacity of 120,000 h.p., with a maximum velocity of about 5 ft. per second. Sufficient capacity is provided in the forebay to keep eight turbines, each of 11,000 b.h.p., working at full load for $1\frac{1}{2}$ hours. The length of pipe line from the forebay to the power-house is 13,000 ft., and the difference in level is 1725 ft. The plant was formally put into service in April, 1915.

Engineering for May 18 contains an illustrated account of a new 15,000-kw. three-phase turbo-alternator recently erected at the Chelsea power station of the Metropolitan District Railway. It is of interest to note that only ten years ago builders were considered greatly daring in constructing turbo-generators of 5000-kw. capacity at 1000 revolutions per minute. Improvements in generator details have been responsible for this notable advance. In view of possible changes in the boiler plant at Chelsea, the new machine was specified to be capable of working with steam at 200 lb. per sq. in. (gauge) and 600° F., but to run its trials at 185 lb. per sq. in. (gauge) and 500° F., giving a superheat of 125° F. only. These test conditions give a steam consumption of about 7 per cent. more than if the tests had been carried out at the higher pressure and temperature. The results under these test conditions, with a vacuum of 0·75 in. absolute back pressure, are as follows:—

Percentage of economical output	50	75	90	100	120
Steam consumption, in lb. per kw.-hour ...	12·9	12·2	11·95	11·8	12·3

The makers are Messrs. C. A. Parsons and Co., Ltd., of Newcastle; Messrs. Merz and McLellan have acted as consulting engineers, and have conducted the tests.

OUR ASTRONOMICAL COLUMN.

PARALLAX OF BARNARD'S "RUNAWAY" STAR.—In the Journal of the British Astronomical Association for April, it is stated that Prof. Schlesinger, of Allegheny, has found a parallax of 0·52", and a proper motion in R.A. of −0·73" for the "runaway" star discovered by Prof. Barnard (NATURE, vol. xcviii., p. 196). Dr. S. A. Mitchell's value for the parallax is 0·47", and that found at Yerkes Observatory by Dr. Lee is 0·55". The true value is evidently very close to half a second. The star thus appears to come second to α Centauri in point of distance, but is the nearest known star which is visible in our latitudes.

DISTRIBUTION OF STARS OF TYPE O.—The important investigations of Prof. Charlier on the distribution and motions of stars of type B (NATURE, vol. xcviii., p. 116) have been extended to stars of type O by W. Gyllenberg (*Arkiv för Matematik*, vol. xi., No. 28). The general principle of the method is that if the temperature and radius be supposed constant for a given class of stars, the distance of each individual star is given by $r=\mathrm{R}.10^{0\cdot 2m}$, where m is the apparent magnitude, and R is the distance corresponding to apparent magnitude zero. In general, R is determined from the proper motions and radial velocities, but alternative methods have been employed by Dr. Gyllenberg for stars of type O (Wolf-Rayet stars). The extension in space and the velocity distribution show a close relation to the B stars, as would be expected if the two classes are contiguous in the spectral sequence. The absolute magnitude of the O stars is −2·78, this being the magnitude at a distance of 1 siriometer (=10^6 astronomical units). This result is in close agreement with Charlier's value −2·45 to −4·78 for the successive sub-classes of the B stars. The O stars, however, show a much larger extension than those of type B in the galactic plane. The density of O stars in the neighbourhood of the sun is 0·0000176 per cubic siriometer.

A similar investigation for A stars has been made by K. G. Malmquist, and for F stars by C. F. Lundahl.

THE MINIMUM RADIATION VISUALLY PERCEPTIBLE.—The recent results of Ives with regard to the least quantity of radiant energy capable of producing the sensation of light (NATURE, vol. xcviii., p. 216) have been further investigated by Prof. H. N. Russell (*Astrophysical Journal*. vol. xlv., p. 60). As before, the metre-candle is taken to be of stellar magnitude −14·18, while a source emitting light of wave-length 0·55 μ, and appearing like a star of the 6th magnitude, is regarded as radiating energy at the rate of $1{\cdot}35\times10^{-8}$ ergs per sec. per sq. cm. The modified factors are those referring to the diameter of the pupil of the eye, and to the stellar magnitude of the faintest visible object. Steavenson's estimate of 8·5 mm. is adopted for the former, and the limiting magnitude is now taken to be 8·5, from observations made by H. D. Curtis and the author. Since a star of magnitude 8·5 gives only one-tenth as much light as one of the 6th magnitude, it follows that the amount of energy which would enter the eye from a light source of maximum efficiency, and of magnitude 8·5, is $1{\cdot}35\times10^{-8}\times0{\cdot}57\times0{\cdot}10$, or $7{\cdot}7\times10^{-10}$ ergs per sec. This is regarded as the best available approximation to the true *minimum visibile*. According to this estimate, the minimum perceptible radiation corresponds to the reception by the eye of about 200 elementary quanta of radiation per second, or of one erg in forty years.

WHALEBONE WHALES OF NEW ENGLAND.[1]

WITH a record of many previous American authors who had studied the whalebone whales of the eastern shores of the United States, it was no easy task for Mr. G. M. Allen to produce anything novel in this monograph. Yet the systematic manner in which he has handled the whole subject, from synonymy to enemies and parasites, renders the memoir both interesting and instructive, especially in connection with the habits, appearances in life, disposition, food, breeding, commercial value, parasites, and capture.[2] Some general questions are also dealt with, such as the notion of Ryder, the late able investigator of the fishes, that the tail-flukes of whales probably represent degenerate hind feet, not the whole limb, as Gray and some earlier authors held; whereas Owen, Huxley, Flower, Parker, and Claus were of opinion that the whole hind limb was (externally) suppressed or atrophied, and that flukes and dorsal fin had been secondarily added. The author's countryman, Gill, also thought that the flukes were derived from the greatly hypertrophied integument of the hind limbs, analogous to the hind limbs of the eared seal, whilst the osseous elements have been atrophied, basing this supposition on the fact that the dorsal and ventral vessels are distinct, and that the *crus*, when present, is in the line of the flukes.

On the shores of New England (that is, from the Bay of Fundy to Rhode Island, or thereabout) six well-known forms occur, viz. the Atlantic right whale (*Eubalaena glacialis*, Bonnaterre), the common rorqual (*Balaenoptera physalus*, L.), the "sei," pollack, or Rudolphi's whale (*B. borealis*, Lesson), the great blue whale, or Sibbald's rorqual (*B. musculus*, L.), the little rorqual, or piked whale (*B. acutorostrata*, Lacépède), and, lastly, the humpback whale (*Megaptera nodosa*, Bonnaterre).

The author takes each species in succession, and deals with it systematically, structurally, and under the other heads already noted. Thus, under the Atlantic right whale, which probably sweeps from pole to pole, the vestigial femur, with its ligamentous rod (tibia?), and the occasional double-headed first rib are noted. It is lively when harpooned, rolling over and over so as to wind the line round its body, and, it may be, upsetting the boat and injuring its crew, or in its active movements striking the boat with its "bonnet" (a process at the tip of the snout). Its numbers have diminished since the early settlers peopled these shores (1620), though they were numerous in 1700, when twenty-nine were killed in one day. Now they are scarce. Its migrations northward and southward, its food (chiefly Thysanoëssa and Calanus), and its breeding are described. In clearing up the synonyms of the next species, the cosmopolitan common rorqual, the author has done good service; and he appears to agree with Kükenthal that it is the third finger which is absent in the *manus*, and not the thumb, since two branches of the median nerve go to the space between the second and third digits. The only trace of a hind limb is a papilla on each side of the anus in the fœtus. In addition to the movements recorded, this finner, in a calm and glassy sea, when reconnoitring, will quietly push its head nearly horizontally out of the water and examine, for instance, a boat with its occupants, and then slip underneath

[1] "The Whalebone Whales of New England." By G. M. Allen. Memoirs of the Boston Society of Natural History, vol. viii., No. 2, pp. 107–322, 16 plates and various text-figures. (Boston, September, 1916.)

[2] The American records of stranded as well as captured whales are creditable so far as they go; but the recently instituted system of notification by the British Government, acting through the staff of the British Museum, is more trustworthy.

almost without a ripple. A fishery for these whales began in 1810, and in 1887 a single ship captured about fifty in a year. The fishery continues still, the whole carcass being utilised, the flesh for feeding cattle, and part of it and the bones forming manure.

Rudolphi's rorqual, again, is rare, and its oil contains less stearine than in other whales. The baleen, however, is the finest of the series, and many of the blades are pure white. Sibbald's rorqual is likewise rare, and goes under the name of the "sulphur-bottom whale," though there is no ground for such a term from its actual coloration. Its fingers are indicated externally in the flipper, even in the fœtus, and the skull has a broader rostrum, agreeing in this respect with the small finner. Little is known of the age of such huge whales, yet the occurrence in the Antarctic seas of giant forms, approaching 90 ft. in length, of a species apparently identical with this would appear to support the view of long life. The small finner or little piked whale is not uncommon, but the author, in mentioning the plicæ of the throat, does not allude to their forking. He found this whale occasionally "breaching"—that is, leaping clear of the water—and that no "spout" was visible, thus in both features differing from the British representatives. Its food on the shores of the United States is chiefly capelin and herrings. Scammon described another closely allied species, viz. *Balaenoptera Davidsoni*, which the author rightly ignores. It refers only to the foregoing. In his account of the last species, the humpback whale, he gives a careful description of the coloration of the flippers (called "fins" throughout the memoir), the upper surface being chiefly white, but that the extent may vary with age, that of the Scotch example harpooned in the Tay in 1884, and described by Struthers, being entirely white. These huge organs (about 12 ft. long and 9 in. thick in a 40-ft. whale) are supposed by the author to be used for swimming, but in the example from the Tay they were used for sounding, especially when efforts were made to drive it on the beach. This form has a rudimentary femur. The vigour and tenacity of this whale and its frequent leaps during its gambols are remarkable. On the whole, the external characters, and even the internal and external parasites of these American Cetaceans, conform to the conditions found in our own waters, a result to be anticipated in forms possessing a range so extensive.

The memoir is illustrated by sixteen excellent lithographic plates and several text-figures, efforts being made even to show the fimbriæ on the edge of the powerful flukes of the humpback whale, but the small outline in this and other cases falls much short of the condition in Nature. Various tables of measurements and records of captures are also interpolated in the text. The Boston Society of Natural History and the painstaking author are to be congratulated on this monograph, which places in the hands of the public a succinct yet comprehensive account of each form occurring in the waters of New England.

W. C. M.

COMMERCIAL AERONAUTICS.

THE lecture delivered on May 30 at the Central Hall, Westminster, by Mr. Holt Thomas, on "Commercial Aviation," should awaken a considerable amount of interest in the commercial possibilities of aircraft after the war. The lecture was in effect a prelude to the meeting of the Civil Aerial Transport Committee, of which Lord Northcliffe is chairman, which has recently been mentioned in these columns. The serious consideration of commercial aeronautics will involve a great deal of scientific work, since the machines which will be necessary for commercial transport will differ in many ways from the types which have been developed to meet the demands of war. Speed will still be an important factor, though not of such paramount importance as in the military aeroplane. Mr. Holt Thomas pointed out that an aerial mail to Paris could be worked profitably at a charge of one halfpenny per ounce, the time of transit being about three hours, and this one instance is sufficient to show the great advantages which aerial transport could confer upon modern commerce. The influence of winds would necessarily render such a mail service more erratic than those now in operation, but the greatly increased speed would more than compensate for this, especially in the case of journeys which now involve both land and sea transport. The question of passenger conveyance is much more complicated than the establishment of aerial mails, as it will be necessary to design machines to give a reasonable amount of comfort to the passengers, especially on the longer journeys. Such difficulties of design are by no means insuperable, and it is practically certain that passenger services will be established in the near future, especially to places not easily served by railway. As Mr. Holt Thomas remarked, the aeroplane could be used to develop outlying places until they grew sufficiently large to warrant the construction of a railway line. The aerial mail will probably come first, owing to the obvious benefits such a rapid service would bring, and to the fact that it would not involve any radical changes in the design of the necessary machines.

Mr. Louis Coatalen, the well-known designer of the Sunbeam Company, delivered an interesting lecture on "Aircraft and Motor-car Engine Design" on May 16 before the Aeronautical Society. He commenced by pointing out the wide differences between the aeroplane engine and the type of engine previously developed for motor-cars. The chief desiderata in the aeroplane engine are lightness and the ability to work continuously at maximum power, and these considerations scarcely affect the design of the car engine at all. The engines designed for racing cars are much more nearly analogous to the aircraft type, and the lecturer remarked that the experience gained on such racing engines was of great value in the early days of aeronautics. The extent to which design had progressed was illustrated by the fact that in two years the weight of aeroplane engines had been reduced from 4·3 to 2·6 lb. per horse-power, and that without sacrificing trustworthiness. The question of valve design received a good deal of attention, the lecturer stating that in his opinion the best arrangement was to use two inlet and two exhaust valves, and to place the sparking-plug in the centre of the cylinder head. Coming from such an experienced and successful designer as Mr. Coatalen, the paper is full of valuable information, and should be read by all who are interested in light petrol motors, whether for aviation or for other purposes.

THE PAST WINTER.

WITH the publication of the Monthly Weather Report of the Meteorological Office for April observations are now complete for the five months December, 1916, to April, 1917, which embrace the abnormally cold and wintry period experienced generally over the British Islands. Temperature results are given in great detail in the reports, and the data afford a most thorough examination of the exceptional character of the weather.

Cold conditions set in towards the close of November and continued until nearly the close of April. The report for December shows a deficiency of temperature everywhere in the British Islands, except at

most places in the north of Scotland, where the average excess was about 0·5° F. At Bath the deficiency amounted to 5°. January had a deficiency over the whole of the United Kingdom, the defect being greatest in the midland, southern, and western parts of England and in Ireland, exceeding 5° in a few places. February had a slight excess of temperature in the Shetlands, Orkneys, and Hebrides; elsewhere it was deficient, the deficiency exceeding 7° at Hereford, and being more than 5° at many places in different parts of England and at a few places in the south of Ireland. March had a deficiency of temperature over the entire area of the British Islands, exceeding 5° at some places in the midland and eastern districts of England. April was everywhere cold, the deficiency of temperature exceeding 5° in many parts, and amounting to 6·6° at Aspatria, in Cumberland.

London is represented by eight stations, including Greenwich and Kew Observatories. The mean temperature, the arithmetical mean of the maximum and minimum readings, from the eight stations for the five months December, 1916, to April, 1917, is 38·0°, which is 3·6° below the average for the whole period. The highest of the several means for London was 39·3° at South Kensington, the observing station of the Meteorological Office, and the lowest Hampstead, 35·9°. The mean of the minimum, or night, readings at Hampstead was below the freezing point in each of the months from December to March, and in April the mean minimum was 33°. At Greenwich the mean of the maximum for the five months was 43·3°, the mean of the minimum 32·3°, and the mean was 37·8°, which is 3·8° below the normal. The means for January and February were both 35·3°, and April, with a mean of 42·7°, had a deficiency of 4·5°, the greatest deficiency from the normal in any of the five months. The mean temperature for the five months was 0·2° higher than for the corresponding period from December, 1890, to April, 1891, and it was 0·1° lower than for December, 1878, to April, 1879, the next lowest mean since 1841, and 0·2° lower than from December, 1844, to April, 1845.

Taking six representative stations in the midlands, for the five months the mean temperature was 36·8°, and the difference from the normal was *minus* 3·9°. At Brighton the mean temperature was 38·6°, a deficiency of 3·9° from the average. In Dublin the mean temperature for the five months was 40·0°, and the deficiency 3·5°; at Jersey 40·7°, and deficiency 4·2°. Three representative stations for Scotland give the mean temperature 37·9°, and the mean deficiency from the average was 2·3°.

Meteorological information from western and northern Europe shows that other parts were similarly affected with prolonged cold.

Dr. Mill, of the British Rainfall Organisation, in a letter to the *Times* of June 4, directs attention to the month which has just closed as being the warmest May at Camden Square, London, since the establishment of observations in 1858. He gives the mean temperature on a Glaisher stand as 59·1° F., or 5·1° above the average, whilst April was just 5° below its average. At Camden Square, May, 1868, had a mean temperature 58·9°, a trifle cooler than the recent May, and it was followed by a very hot summer. Dr. Mill quotes several warmer Mays according to the old London records, and mentions that only in 1809 did an extremely warm May follow, as this year, an extremely cold April. At South Kensington, the observing station of the Meteorological Office, the mean temperature in a Stevenson's screen for May was 59·6°. The Greenwich observations give 58·8° in 1841 and 1848 as the previous highest May temperatures, from maximum and minimum readings, since 1841, and in 1893 the mean was 58·4°. In 1908 at Greenwich the mean temperature for April was 44·3°, which is 4° below the average, whilst that for May was 56·7°, or 3° above the average. The following summer was by no means fine or hot.

CHAS. HARDING.

THE COOLIDGE X-RAY TUBE.

THE Coolidge X-ray tube has been on its trial in this country during the last two years, and it may be said with some confidence that it has gone a very long way towards justifying the claims which have been made concerning it. Whether the tube be judged from the laboratory or from the clinical point of view, it marks a new era in the history of the X-ray tube. There is now to the hand of the experimenter or of the radiologist a source which provides him with a beam of X-rays which can be varied in the course of a few seconds, as regards both quality and output, over a very wide range; such radiation, moreover, may be repeated with certainty.

The work of Sir E. Rutherford and his colleagues, which was directed to find the shortest wave-length of the radiation emitted by the Coolidge tube, disclosed the fact that a limit was set to the penetrating power of this radiation when the potential difference between the terminals of the tube was about 150,000 volts. The Coolidge tube can be run at a higher working voltage than the ordinary X-ray tube owing to the absence of any measurable quantity of gas within the former, and the range of radiation emitted by it extends rather further into the region of the shorter wave-lengths than is obtained with the older type of tube.

There is a considerable clinical use of such very penetrating rays, which are rather more penetrating than the γ rays from radium-B, but less so than those emitted by radium-C. The difficulty of protecting those who apply such radiation is considerable, but the necessity for so doing is no less urgent than it is apparent, and we are glad to see that prominence is given to this question in a descriptive leaflet of the Coolidge tube, dated October 31, 1916, issued by the British Thomson-Houston Co., Ltd.

This memorandum contains a description of the tube, its mode of construction, and the methods which are now generally employed in its manipulation, both for radiographic and for radio-therapeutic work.

Considering the ease with which the Coolidge tube may be manipulated, and the short time which is required by anyone conversant with X-ray matters to acquire the necessary technique, it must be inferred that the only hindrance to its more general adoption in this country is the high cost of the tube.

The Coolidge tube may perhaps be looked upon as the most successful practical application which has yet been made of the classical work of Prof. O. W. Richardson on thermionic currents. We trust that the British Thomson-Houston Co., Ltd., which states that it is the owner of the English patents of this tube, will be instrumental in putting the Coolidge X-ray tube within the reach of a wider public than exists to-day.

THE ROYAL OBSERVATORY, GREENWICH.

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was presented at the annual visitation of the Observatory on June 1. A few of the matters dealt with in the report are here summarised.

The catalogue of stars down to 9·0m. on the B.D. scale between the limits of 24° and 32° of north declination has been completed by the determination of

the proper motions of about 12,000 stars. These have been obtained by comparison of the Greenwich positions with those given in the catalogues of the Astronomische Gesellschaft and the earlier catalogues of Bessel and Lalande. For the latter catalogues systematic corrections were determined for each separate night's observations.

A determination of the mean parallax of stars of different magnitudes has been made from these proper motions and published in the Monthly Notices of the Royal Astronomical Society. The results confirm very closely the formula given by Kapteyn. It is hoped to communicate to the society a short discussion of the proper motions with reference to star streaming. The publication of these summaries of results by the Royal Astronomical Society is specially valuable because of the delay in the printing and publication of the catalogue itself.

During the year 222 photographs were taken with the Cookson floating zenith-telescope, 216 for latitude groups and six for scale determination The measurement of the photographs to the end of 1916 is completed, and the results for the variation of latitude for 1916 were communicated to the Royal Astronomical Society, and published in the Monthly Notices for March, 1917.

Throughout the year the 28-in. refractor was at the disposition of M. Jonckheere. Fifty-nine new close double stars were detected, making 259 since October, 1914. Up to November 22, 1916, the observations mainly consisted of the measurement and verification of stars discovered to be double since 1905, the date to which Mr. Burnham's catalogue extends. Since November 22 the programme of work has comprised (1) the measurement of stars from Burnham's General Catalogue which had been previously observed at the Lille Observatory, and (2) the re-measurement of double stars in vol. lxi. of the Royal Astronomical Society's Memoirs. Altogether 604 double stars have been measured during the year. Of these stars—

213	have a separation under 2″.		
156	"	"	between 2″ and 3″.
132	"	"	" 3″ " 4″.
62	"	"	" 4″ " 5″.
41	"	"	greater than 5″.

The catalogue of double stars discovered since 1905 has been published by the Royal Astronomical Society in vol. lxi. of the Memoirs.

With the Thompson equatorial, in accordance with the programme of previous years for the determination of stellar parallax, a first exposure has been made on eighty-six plates, and a second one on 154 plates. At the request of Dr. de Sitter the series of photographs commenced at the Cape Observatory for the determination of the constants of the four Galilean satellites of Jupiter has been continued at Greenwich.

With the astrographic equatorial during the year 109 plates have been taken on thirty-five nights for the determination of proper motion by comparison with earlier plates. Of these nine have been rejected; eighty-five plates, of which fifty-two have two fields on them, have two short exposures, usually of 4m. and 2m.; fourteen have a single exposure of 12m.; one is for focus of the instrument.

The plates with short exposures are being compared in the duplex micrometer, but only for the stars contained in the *Bonn Durchmusterung*. The plates with longer exposures are being compared with earlier plates—usually chart plates—by Mr. Innes at Johannesburg, using a blink microscope. With the duplex micrometer 177 pairs of plates have been measured during the year. From the results obtained all proper motions greater than 10″ a century and many smaller ones are being determined. Simultaneously the proper motions of the brighter stars are being determined by comparison with earlier meridian observations.

In the year ended May 10 1917, photographs of the sun were obtained on 208 days. Photographs have been received from the Royal Observatory, Cape of Good Hope, and supplementary photographs have been received through the Solar Physics Committee, from Dehra Dûn, India, in both cases to the close of the year 1916. Two days in 1916 still remain unrepresented, viz. June 19 and September 29. From 1910 to 1916 inclusive there are only two other days unrepresented in the combined series of photographs for measurement, one in 1911 and one in 1912

The mean daily spotted area of the sun continued to increase during the past twelve months, and there is no indication as yet that the maximum has been reached.

The mean values of the magnetic elements for 1916 and five previous years are as follows:—

Year	Declination W.	Horizontal force (C G S)	Dip
	° ′		° ′ ″
1911	15 33·0	0·18549	66 52 6 (3-in. needles)
1912	24·3	0·18548	51 46 " "
1913	15·2	0·18534	50 27 " "
1914	15 6·3	0·18518	49 27 " "
			51 13 (inductor)
1915	14 56·5	0·18508	51 50 "
1916	46·9	0·18494	52 45 "

It will be noticed that the annual diminution of declination increased considerably about 1910, its average value from 1900 to 1910 being 4·9′. The horizontal force, which had been increasing since measurements at Greenwich were begun in 1846, reached a maximum about 1910, and is now diminishing. The dip, which has been diminishing since measurements were begun in 1843, appears also to have recently reached a turning point. There were no days of great magnetic disturbance in 1916, but three were classified as of lesser disturbance.

The principal features of interest in the meteorological conditions at Greenwich during the year ended April 30, 1917, are:—(i) The continued cold weather from December to April—the latter month had a mean temperature 1° lower than any other April since 1841; and (ii) the general deficiency of sunshine.

The scientific work of the observatory has necessarily been somewhat curtailed, but it has been found possible to keep up all observations of the sun, moon, and planets; sun-spots; latitude; magnetic and meteorological registers—observations which would otherwise have been permanently lost.

One special piece of work to which a good deal of attention was devoted this year was the preparation of magnetic charts. In 1912 it was arranged that the compilation of the Admiralty charts of magnetic variation, hitherto undertaken by the Compass Department, should be transferred to the Royal Observatory. A card catalogue of magnetic declination data from all parts of the world was formed. From this and published data of various surveys the charts for 1917 have been prepared during the past year. They are now in course of publication by the Hydrographic Office.

RESEARCHES ON KALA-AZAR.[1]

I HAVE chosen the subject of twenty years' research on kala-azar for the main portion of my address to-night, both because of the great importance of this disease in a large area of India, and also of the ignorance of the general public regarding it. Most people have fairly definite ideas about malaria and

[1] From the presidential address delivered to the Asiatic Society of Bengal on February 8 by Sir Leonard Rogers, F.R.S.

cholera, but few have any regarding the far more deadly and insidious kala-azar, which, on account of its extremely high mortality and the painfully lingering nature of the disease, is without doubt the most terrible scourge occurring in India. It is now more than twenty years since I was fortunate enough, when with less than three years' service, to be selected to carry out the second investigation of the Assam epidemic of kala-azar, and it has never ceased from that time to occupy my thoughts, although my opportunities for continuing my researches on it have sometimes been more limited than I should have liked. Fortunately, I have been able to discover how to prevent the spread of the disease, and also independently to find a cure for it. The time, therefore, seems to be ripe for giving a brief popular summary of the progress which has been made in our knowledge of kala-azar through the researches of the last twenty years, which has resulted in a very great degree of success as regards both the prevention and the cure of the disease, although some links in the chain of infection still remain to be forged.

In the first place, I wish to remove a misconception which I find is commonly prevalent among the public, namely, that kala-azar and black-water fever are the same disease, or at least intimately related. It is true that some years ago a high medical authority did make such a suggestion on theoretical grounds, but I do not think any medical man now holds that view. As a matter of fact, it would be difficult to imagine two more widely different conditions than the lingering kala-azar and the short, sharp, black-water fever complication of malaria, which ends in death or recovery within a very few days. That black-water fever is but a complication of malaria is a view with which I am in agreement. But the differentiation of kala-azar from chronic malaria was not possible before the discovery of a distinct parasite in the former in 1903, and up to quite recently it remained very difficult on purely clinical grounds in many cases. It is, therefore, not surprising that the two were for long confused even by research workers, including myself in my report of 1897 on the Assam epidemic, and a little later by such a great authority on malaria as Sir Ronald Ross, who proved malaria to be mosquito-borne.

It is generally known that kala-azar spread through Assam for a number of years, causing a great mortality; but it is difficult to convey to those who have not seen its effects anything like an adequate idea of the terrible nature of the affliction. At the time of my investigation in 1896–97 the disease was at its height in the Nowgong district, the population of which in the decade 1891–1901 actually showed a decrease of 31·5 per cent., against an increase of 9 to 16 per cent. in the more easterly unaffected districts. Large areas of land fell out of cultivation, and even at the headquarters town of Nowgong land absolutely lost its value, being quite unsaleable. When the tea-gardens became infected in this district, and accurate figures were available, it was found that the mortality in several hundred carefully treated cases varied from 90 to 96 per cent.

But I must pass on to show you some photographs of cases taken during my investigation. The first group was taken in the Nowgong dispensary, and the second in that at Mangaldai. Both show the great emaciation contrasting with the tumid abdomens due to great enlargement of the spleen, and often also of the liver, while the skin becomes darker and more muddy, which, according to some, gave rise to the term kala-azar or black fever. Now it will no doubt occur to many of you that you have seen precisely similar cases in malarious areas round Calcutta, and you will ask, How do you differentiate between kala-azar and chronic malaria? That, indeed, was the problem which confronted me in Assam, with the added difficulty that the disease was spreading and causing an awful mortality such as malaria was not known to do in Lower Bengal, and that the people themselves had no doubt that the disease was an infectious one, though malaria was not believed to be so at the time of my investigation, which, of course, was several years before the mosquito-borne theory of malaria was established. In fact, there were at that time two rival theories regarding kala-azar: one that the disease was malarial, and therefore could not be infectious; and the other that it was infectious, and therefore could not be malarial, so must be some undescribed disease. I early set to work to find out if kala-azar was infectious. I found that the disease always began in a village through an infected person coming to reside there, the next to be attacked being those living in the same house as the infected visitor. This naturally led me to suspect that the disease was not malarial, yet I frequently found malarial parasites in the blood (it was not then known that in malarious parts many apparently healthy persons harboured malarial organisms in their blood), and, search as I would, I could find no differentiating point from malaria. I therefore visited Sylhet, to the south of the Khasia Hills, where kala-azar was then unknown, and there found cases of malarial cachexia which in every respect, including investigations of the blood changes, resembled kala-azar of the Brahmaputra Valley, except that they were much more chronic and sometimes lasted as many years as epidemic kala-azar did months. With the boldness of comparative youth I therefore declared the spreading kala-azar of Assam to be an epidemic infectious form of malaria, corresponding in some respects with the well-known Mauritius malarial epidemic of 1877. We shall see presently that I was partly wrong and partly right in coming to this conclusion.

However, I was not content with merely theoretical considerations, but strove for practical results from my inquiries. I therefore sought for more accurate data on the tea-gardens, which had become badly infected in the Nowgong district, and on which I investigated many cases with the help of my friend, Dr. Dodds Price, who has a unique experience of kala-azar and has rendered me the greatest possible assistance throughout a number of years. I ascertained that on one of his gardens so many deaths had occurred from kala-azar that two hundred new coolies had to be imported at one time. He had already independently recognised the infectiousness of the disease before I went to Assam, and had arranged for separate coolie lines to be built to prevent as many as possible of the new coolies going into the infected houses of the old lines. Only one hundred and fifty could be accommodated in the new lines, so fifty had to go into the old ones. On learning this, I at once set to work to ascertain the results of this important measure, and we found that in the course of two years no single case of kala-azar had occurred in the new lines (and the same was true eighteen years later), while no fewer than 16 per cent. of the new coolies living in the old infected lines were already dead of the disease, although the two sites were only about two hundred yards apart. This experience led me to urge moving out all the healthy people from the infected lines into new ones, taking none from infected houses, segregating the remaining infected families, and destroying the old houses. The results were so successful that the plan was repeated by Dr. Price on other gardens, and in 1913, during a visit to Assam in the Puja vacation, we worked out the results of eighteen years' experience. This may briefly be summarised by saying that the dread disease had been

completely stamped out of ten coolies' lines, in one of which three-fifths of the whole population had the disease in their households, while the new lines had afterwards remained free from the disease in every case, namely, from twelve to eighteen years in five of them, and for shorter periods in the others, no recurrence having ever taken place where Dr. Price had been able to get his orders carried out by the garden managers to prevent any infected person being allowed to live in the new lines. That this success was not due to the decline of the disease in the Nowgong district was clear from the fact that on two gardens where he could not get the managers to adopt my measures the disease was still present at the time of my 1913 visit, having persisted on them for twenty years. When it is stated that the population of the new kala-azar-free lines in 1913 amounted to 6727 souls, and that the deaths from kala-azar alone in the old lines before removal had amounted to 1393, or no fewer than 207 per mille, more than one-fifth; that the loss would have continued indefinitely, as shown by the fact that the disease remained present for twenty years on two gardens where the plans were not adopted; and that coolies cost about Rs.200 a head to recruit by the time they reached Assam, the saving to the tea industry in this one district alone must have amounted to lakhs of rupees. I am glad to be able to say that the industry has shown its gratitude in a very practical way by promising Rs.20,000 a year for five years for investigations in connection with the School of Tropical Medicine

The more difficult question remained as to whether anything could be done to check the spread of the disease up the Brahmaputra Valley. On turning once more to the map, you will see that the only traffic eastward is along the narrow strip between the hills and the Brahmaputra River, which also has comparatively few inhabitants. I found it to be free from kala-azar in 1897, so recommended that steps should be taken to stop infected people from passing up into the Golaghat subdivision of the Sibsagar district, and that if any villages became infected in Golaghat the segregation measures should at once be carried out and the healthy people moved to a new site. This was actually done later with success, and as the epidemic has abated in Nowgong, although sporadic cases remain, there is good reason to hope that the main danger has been averted and the eastern part of the valley saved from devastation little, if at all, less disastrous than the war itself. A recent investigation by Major McCombie Young, Sanitary Commissioner, Assam, has shown that the disease remains in a sporadic form in just those parts of Assam which I found to be infected with the epidemic twenty years ago—an important point I shall return to presently. Before leaving this part of the subject let me emphasise the fact that all the above practically important prophylactic measures were worked out as a result of my epidemiological studies before we had any accurate knowledge of the true nature and causation of the disease, so that, however wrong my theories proved to be, I have the satisfaction of knowing that my earliest important investigation in India led to much saving of life and suffering, which has always been a greater satisfaction to me even than the making of purely scientific discoveries without much practical value.

In the meanwhile, my theory that kala-azar was an epidemic malaria, although supported by the high authority of Sir Ronald Ross, was criticised by others, and Dr. Bentley, on the strength of what ultimately proved to be erroneous blood tests made at Kasauli, declared the disease to be an epidemic of Malta fever, but at the same time brought forward some strong arguments against the disease being malarial. While opinions were thus divided in India, researches on two other continents led to a solution of the difficult problem—so closely is scientific thought all over the world united by medical literature at the present day. In Africa the late Dr. Dutton, the most brilliant worker yet produced by the Liverpool School of Tropical Medicine, discovered a trypanosome in the blood of a patient suffering from a fever, which was later proved by Sir David Bruce to be the early stage of the deadly sleeping sickness. Sir William Leishman then recorded having found some minute bodies in the spleen of a soldier who died in England of a fever contracted in Dum Dum, and suggested that they were degenerate trypanosomes. Lt.-Col. C. Donovan, of the Madras Medical College, immediately announced that he had independently found the same bodies some months before, and added the important fact that they could be obtained by spleen puncture during life, thus disproving Leishman's theory that they were degenerate trypanosomes. Donovan also suggested that the so-called malarial cachexia and kala-azar might also be due to this parasite. Leishman and Donovan were therefore the joint discoverers of the parasite of kala-azar which is called after them, and I am glad to say that the Asiatic Society has been the first to recognise the importance of Donovan's work by electing him to our fellowship last year, although it is but a small recognition for such an important discovery. The way was now cleared for more rapid advance, and Dr. Bentley and myself independently found the same parasite in epidemic kala-azar in Assam, and I also found it in cases in the north-west of the Dinajpur district, where the disease had been known as kala-dukh. Thanks to the kindness of the physicians of the Medical College Hospital in 1904–5, and especially to Surgeon-General Harris, I was able to investigate scores of cases of what had hitherto been always regarded as malarial cachexia, with the result of showing that a large proportion of them were kala-azar.

These observations established the important fact that a sporadic form of kala-azar is widely prevalent in Lower Bengal, and I found it to be exactly similar to the cases I had formerly studied in Sylhet. The mystery of the nature of kala-azar was thus cleared up, the destructive Brahmaputra Valley wave having been an epidemic form of the disease which is epidemic in Lower Bengal and Sylhet; so that, although I was wrong in regarding it as malarial, I was correct in saying it was an epidemic variety of the disease I had found in Sylhet, which had always been regarded as malarial cachexia, but which we now know to be sporadic kala-azar. As special skill and laboratory facilities are required for demonstrating the parasite of kala-azar, while the treatment of kala-azar is different from that of chronic malaria, it still remained a matter of great practical importance to solve the century-old problem of finding a simple clinical differentiation between kala-azar and malarial cachexia. Only in January I recorded the results of three years' investigation of this problem in the Medical College Hospital, thanks to facilities kindly afforded me by my medical colleagues, which has, I believe, resulted in a simple and practical solution of this difficulty, and will enable the curative treatment I shall come to presently being successfully used by the general practitioner, even in places remote from laboratories.

The discovery of the parasite of kala-azar in 1903 placed me in a position to study it with the view of ascertaining its life-history, and so to obtain a clue to the mode of infection. In the following year I was

fortunate enough to succeed in cultivating this protozoal parasite in test-tubes under certain conditions and in watching the minute spleen form develop into a long flagellate organism resembling one of the stages of a trypanosome, but which further study showed to belong to the closely allied herpetomonas. This discovery gave the required clue to the nature and probable life-history of the parasite, as similar organisms are found naturally in the digestive canals of certain flies, indicating that the infection is probably insect-borne. I spent the next year in studying the conditions favourable to the growth of the parasite in cultures, and for reasons into which I have not time to go I came to the conclusion that the homely bed-bug is the carrier of the disease. The fact which had by this time been established by Dr. Dodds Price, that two to four hundred yards is a sufficient distance to remove healthy lines from infected ones, is sufficient to exclude a flying insect such as a mosquito. At this time Major Patton, of the Bacteriological Department, was placed on special duty to work at the subject in Madras. After some two years' work he obtained a development of the parasite up to the flagellate stage in the digestive canal of bed-bugs fed on kala-azar patients with the parasites in their blood. Lt.-Col. Cornwall has recently confirmed these experiments, and although the final proof of communicating the disease by means of infected bed-bugs has not yet been furnished (experiments on human beings, such as were carried out in the case of malaria, not being justifiable in the deadly kala-azar), still the evidence incriminating these insects is sufficiently weighty to make it desirable to wage war upon them wherever the disease is present. Coco-nut oil applied to the runs of the bugs on walls, and to the buttons of mattresses, etc., where they often hide, is a useful measure for this purpose. As these insects can live for months without food, the way in which the infection clings to houses is well explained on my theory that they are the carriers of the disease.

Lastly, I come to the most important discovery regarding kala-azar, namely, that of a trustworthy cure of this formerly very deadly disease. Antimony preparations have proved to be of value in trypanosomiasis, and nearly two and a half years ago I decided to try intravenous injections of tartar emetic in kala-azar. Unfortunately, just at that moment I had no clinical facilities for testing my idea, and for six months I carried about sterile capsules of tartar emetic without being able to use them, a disability which will end when the Carmichael Hospital for tropical diseases is opened. Eventually I obtained the facilities I required, and soon saw reason to believe that the drug was proving effective. Imagine my disappointment when I read that two Italian doctors had recorded successes in the treatment of the African form of kala-azar with the very drug I was using in Calcutta, although the fact that I had independently discovered the treatment will save some of the credit for the Indian Medical Service. At any rate, I am now in the happy position of being able to say that, thanks to the kind help of Capt. H. N. Hume and Lt.-Col. O'Kinealy, no fewer than twenty-five consecutive cases of kala-azar, including three children, have been successfully treated in the European General Hospital by this method, and the most deadly disease of India, if not of the world, has now been largely conquered, as regards both prevention and cure, perhaps more completely than any other highly lethal disease known, as a direct result of the researches of the last twenty years.

In conclusion I cannot resist this opportunity of pointing the moral, namely, that no greater benefit can arise than from successful medical research, and that no better use can be made of wealth than in endowing such research for the benefit of the present and all future generations. Bengal, and I would add Bihar, have already nobly responded to my appeal for endowments for the Calcutta School of Tropical Medicine, and when the terrible war is over we hope to have at least nine research workers in the new laboratories, instead of one poor man with routine professorial duties devoting such time as he can snatch to medical research.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. A. E. Shipley, F.R.S., master of Christ's College, has been elected Vice-Chancellor for the next academical year.

OXFORD.—A decree passed by Convocation on June 5 provides for the suspension of the Romanes lectureship until October 9, 1917, the moneys consequently undisposed of to be transferred to the Emergency Relief Fund of the University.

On the same day statutes passed Congregation empowering the board of the faculty of medicine to recognise certain examinations in natural science, and providing for the further promotion of higher studies in the University, with special reference to the proposed new degree of Doctor of Philosophy. The statutes respecting boards of electors to professorships were amended in some particulars.

Mr. T. R. Glover, fellow of St. John's College, Cambridge, has been appointed Wilde lecturer in natural and comparative religion for three years from October 10, 1917.

Prof. Emile Boutroux, Membre de l'Institut de France et de l'Académie Française, has been appointed Herbert Spencer lecturer for 1917.

Two courses of free public lectures have just been commenced at the School of Oriental Studies, London Institution, Finsbury Circus, E.C.2. One course, on "Religion in India and China," is being delivered by Dr. T. W. Rhys Davids, and the remaining lectures will be given on Tuesdays, June 12, 19, and 26; the other course, on "The Way to Buddhahood," by Prof. de la Vallée Poussin, is being delivered on Thursdays, June 7, 14, 21, and 28. The lectures begin at 5.30 in each case.

THE President of the Board of Education has appointed a Departmental Committee to inquire into the principles which should determine the construction of scales of salary for teachers in elementary schools, due regard being had to locality, duties, qualifications, sex, and other considerations consistent with the organisation of the teaching service throughout the country, on a system conducive to the efficiency of national education. The committee will be at liberty to illustrate any system of scales which it recommends by such specific sums of money as it thinks fit; but it is not asked to consider the question of the amounts by which existing scales of salary should be improved in particular areas, or the sources from which the amounts required for that purpose should be provided. The members of the committee are:—Sir H. L. Stephen (chairman), Miss M. M. Allan, Mr. J. W. Alsop, Dr. H. B. Brackenbury, Miss I. Cleghorn, Mr. C. W. Crook, Mr. W. R. Davies, C.B., Miss I. A. Dickson, H.M.I., Mr. A. J. Flavell, Mr. H. Mellish, Mr. H. Pearson, Mr. A. R. Pickles,

Mr. W. Pullinger, Mr. F. Roscoe, Mr. T. H. J. Underdown, Miss Hermione Unwin, the Rev. D. H. Williams, with Mr. A. H. Wood as secretary, to whom all communications should be addressed at the office of the Board of Education. Mr. Fisher intends also to deal with teachers in secondary, technical, and other schools by a further reference to a second committee connected with this committee in respect of both constitution and functions.

An illustrated brochure entitled "Women on the Land" has been issued in which a description of the training of women and girls for agricultural and market-garden work at "Craigendowie," Broughton, near Preston, is given. Under the Lancashire committee a month's training was provided for, but Mrs. Ritchings, who has undertaken the work of training the girls on her own estate, has wisely continued the course of instruction for a second month. The number of students taken at one time is about twelve, and probably it is possible to give much more thorough instruction in the use of tools with a small number of students than with the unduly large numbers which are sometimes crowded for a month into training centres. Although none of the women students at "Craigendowie" had had previous experience of agricultural work of any kind, the results seem to have been very successful, and the women have been drafted out to situations in Lancashire and Cheshire. The reports given by various training centres and the accounts received from farmers, which have been published from time to time in the *Journal of the Board of Agriculture*, show clearly that women are capable of doing valuable work on the land, provided that the farmers will give them a fair trial and a certain amount of preliminary instruction of a clear and practical kind. With the care of dairy cows and other stock women seem to have been particularly successful, though they have carried out satisfactorily almost every type of agricultural work. In view of the necessity for increased cultivation, the demand for women's work on the land will rapidly increase during this year, and it is of the greatest importance that it should be satisfactorily met. Training schools have fortunately been established in many counties, and if women can be assured of suitable accommodation and adequate wages, large numbers will doubtless take up an employment which has been re-discovered as healthy, interesting, and absolutely essential to the welfare of the nation.

BOOKS RECEIVED.

Three Lectures on Experimental Embryology. By Dr. J. W. Jenkinson. With a Biographical Note by Dr. R. R. Marett. Pp. xvi+130. (Oxford: At the Clarendon Press.) 7s. 6d. net.

A Sketch Map of the Linguistic Areas of Europe. (London: E. Stanford, Ltd.) 2 guineas.

The War and the Nation: A Study in Constructive Politics. By W. C. D. Whetham. Pp. viii+312. (London: J. Murray.) 6s. net.

Rings for the Finger, from the Earliest Known Times to the Present. By Dr. G. F. Kunz. Pp. xviii+381+illustrations. (Philadelphia and London: J. B. Lippincott Co.) 28s. net.

The Home and the Family: An Elementary Textbook of Home Making. By Profs. H. Kinne and A. M. Cooley. Pp. vi+292. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3s. 6d. net.

Fresh-water Wonders and How to Identify Them. By J. H. Crabtree. Pp. 64. (London: C. H. Kelly.) 1s. 3d. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—The Art of the Biographer. A. C. Benson.

LINNEAN SOCIETY, at 8.—The Hooker Lecture on The Natural Classification of Plants: Prof. F. O. Bower.

CHEMICAL SOCIETY, at 8.—The Constitution of Internal Diazo-oxides (Diazophenols). Part ii: G. T. Morgan and H. P Tomlins.—The Determination of Ozone and Oxides of Nitrogen in the Atmosphere: F. L. Usher and B. S. Rao.—Thiocarbamide and Esters: J. Taylor.—The Phosphates of Calcium. Part iv. The Basic Phosphates: H. Bassett, jun.—Preparation of Secondary Arylamines free from Primary Amines: J. Thomas.—Some Double Compounds of Ferric Chloride with Ethers A. Forster, C. Coope, and G. Yarrow.—The Absorption Spectra of some Polyhydroxyanthraquinone Dyes in Concentrated Sulphuric Acid Solution and in the State of Vapour: D. B. Meek.—Action of Acetaldehyde Ammonia on Quinones: P. C. Ghosh.—The Exact Determination of Morphine in Complex Mixtures. Part i. A Collection and Revision of Data: A. Tingle.

FRIDAY, JUNE 8.

ROYAL INSTITUTION, at 5.30.—Industrial Applications of Electrons: Sir J. J. Thomson.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—A Bridge Method of Comparing Fixed Inductances: T. Parnell.—The Radiation from Loaded Antennæ: Van der Pol. —A Demonstration of a Method of Preventing Sparking at a Rapid "Make and Break": Dr. A. Griffiths.

SATURDAY, JUNE 9.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—The Conception of a Cosmos: Prof. J. S. MacKenzie.

SUNDAY, JUNE 10.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—Symposium: Are the Materials of Sense Affections of the Mind?: Dr. G. E. Moore, W. E. Johnson, Prof. G. Dawes Hicks, Prof. J. A. Smith, and Prof. James Ward.

THURSDAY, JUNE 14.

MATHEMATICAL SOCIETY, at 5.30.

FRIDAY, JUNE 15.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—The Spontaneous Firing of Coal: Dr. J. S. Haldane.—The By-product Coking Process, its History, Development, and Application: E. Bury.—Acetylene Mine Lamps: W. Maurice.

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THURSDAY, JUNE 14, 1917.

PSYCHOLOGICAL MEDICINE.

Manual of Psychiatry. By Dr. J. Rogues de Fursac and Dr. A. J. Rosanoff. Fourth edition. Pp. xi+522. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10s. 6d. net.

WAR has always been the most potent cause of mental and physical suffering among a people; apart from the many direct injuries such as wounds, sickness, and fever which are inflicted upon the fighting forces. In war, military necessities must precede any consideration for the civil population, which experiences "stress and strain," two factors that contribute more than any other to the causation of insanity. For this reason we should expect a greater incidence of insanity during war than in peace-time; yet, although this war has lasted nearly three years, and much pain, great sorrow, and almost unendurable grief have been borne, there has been less registered insanity than occurred before the war, and on January 1, 1916, there were 3278 fewer cases than the year before. The causes for this diminished incidence are many. In the first place, it is a fact of experience that one great emotion is less frequently the cause of insanity than are the many small, but continuing, marginal, sub-conscious worries, which are always just within the limits of consciousness. It is also common knowledge that the working classes as a whole have been better off financially than in peace-time: the enormous demands of the world-war have created work on a colossal scale; the great industries of the country have been transformed into factories for the output of munitions and into workshops for the production of material for military requirements, and every responsible civilian capable of useful work has had his or her attention fixed, his or her interests maintained, and his or her domestic anxieties relieved. In spite of the greatly enhanced cost of living, difficulties connected with ways and means have even been less felt than in normal times, so that this diminution may be only temporary and due to social and economic conditions.

Other reasons for the diminished incidence of insanity are, first, the fact that the Liquor Traffic Control Board, exercising its powers under the Defence of the Realm Act, has curtailed the opportunities for drink—as alcohol accounts for 20 per cent. of all insanity among men, and 10 per cent. among women—and secondly, and probably the main reason, insanity occurring among the five millions of our troops is now unrecorded. This latter fact is of the utmost importance, because in all previous wars the soldier disabled through a mental illness was certified under the Lunacy Act, registered, and removed for treatment into the asylum in which he had a territorial settlement, whilst in the present war no insane soldier has been certified to be insane until he was deemed to be incurable. When insane, he is now detained under Military Law and maintained in a "military hospital," the latter in many instances a county asylum taken over by the War Office exclusively for the treatment of the soldier. This procedure has been adopted in order to avoid the possible stigma of having suffered from an attack of insanity should the soldier recover and desire to re-enter civil life. In giving sanction to this policy the Director-General of the Army Medical Department has acted wisely and considerately towards the insane soldier, and up to the present the experiment has worked satisfactorily, and it is because of this separate management of the mentally disabled soldier that a review of a text-book upon insanity is both appropriate and opportune.

This text-book by Dr. de Fursac is well known in this country, and its popularity is confirmed by the fact that this is its fourth edition; but it is in the main an American revision, and out of more than 350 references to authors in the text-book not above a dozen refer to English contributors. As in most American works upon mental diseases, the classification of insanity comes from Germany: the scheme is confused; it classifies insanity partly upon the basis of factors of causation, *e.g.* alcoholic insanity, syphilitic insanity, thyrogenic insanity, and partly upon the form of the mental disorder, so that a case may be in more than one group at the same time, and the groups are, therefore, not mutually exclusive. Moreover, the terms "manic-depressive insanity" and "dementia precox" find a prominent place. They refer, of course, to the varieties "alternating insanity" and "primary dementia" of our English classification. In regard to the technicalities of certification—a matter of vital importance to the family physician and to the general practitioner—the text-book is useless. It refers to "commitment" as the equivalent of certification, and upon this point of procedure it affords no guide according to English, Scottish, or Irish law. Nevertheless, the work is a helpful and instructive manual to the student of psychiatry.

Under ætiology, a section is introduced upon the Mendelian theory, which is not yet perfect enough to deal with the complex mental characters of human beings. In the mental constitution of human beings it is certain that "the segregation of unit-characters" does not occur, because the mind of each person is a hybrid blend, and the blended conditions appear in succeeding generations. The so-called law of dominance is quite an irregular phenomenon in Mendelism, as we know from the crossing of the "Chinese" with the "star" variety of primula, the cross between these two types being intermediate in form and easily distinguishable from either of the pure types, the characteristics having become blended. In human beings mental characteristics are complex states and not segregated units. There is no "purity" in the reproductive cells with regard to these characters, *i.e.* the hybrid condition that results as a blend

is not represented in a single reproductive cell, for the organism is always a double structure. On the other hand, we know that certain physical characters are definitely inherited upon Mendelian lines; for instance, colour in plants and animals, certain hair and feather characters, leaf forms, the presence or absence of horns in cattle, the shape of potato-tubers, are thus inherited; as are also brachy-dactyly, nyctalopia, and other conditions in man.

Although certain abnormal characters in individuals may be conveniently described as dominant or recessive, this is far from being a full explanation of neuropathic inheritance. The "coupling" and "repulsion" known to exist between different factors, the explanation of "sex-limited" diseases, and even the causation of sex itself, fail to be explained upon evidence which is founded upon Mendelian lines alone. In regard to Mendelism we think there is too much stress laid in the text-book upon the statement that "actual findings in mental disorders are alongside of theoretical expectations." As yet we know too little to be able to state that Mendel's law applies to all characters of all living organisms. Mental disorders in themselves are too vague as well as too subtle and complicated to be classified into definite heritable unit-characters. All we can say is that we must not expect simple Mendelian results from the study of insane inheritance, which is a product of many factors, each of which may possibly be independently heritable, but all of which have certain definite effects that must necessarily interfere with the practical application of Mendelism. The irregular dominance of some abnormal mental states shows that there is no definite segregation of mental characters.

The references to cerebral syphilis in the manual are the only long quotations from any English authority, and these do not point out that mental symptoms, such as cerebral irritation, restlessness, excitement, anxiety, and depression, occur in no fewer than 80 per cent. of all cases of syphilis, and mostly during the secondary stage! It is agreed by English authorities that these mental symptoms occur within six months from the date of primary infection. The author is too optimistic about the Wassermann reaction remaining negative after one or two injections of salvarsan. Exceptionally this may be so, but the present treatment of syphilis extends to more than one hundred days, and consists in the intravenous or intramuscular injection of salvarsan, neo-salvarsan, gallyl, luargol, or kharsivan, combined with mercury; and cerebral syphilis receives identical treatment. No reference is made to the numerous experiments made with salvarsanised serum, and we share the author's doubt as to the permanent arrest of general paralysis or of locomotor ataxia.

The Binet-Simon tests of mental deficiency are introduced and occupy about twenty pages, but it would have been more helpful if the author had added fuller comments upon their interpretation and practical utility. No mention is made of the Montessori method of treating mental deficiency, for this would have been appropriate in a work purporting to cover all inherent mental weakness. A useful sub-section is given to the technique of the Wassermann reaction, but, although the hæmolytic system is used to explain the bacteriolytic, the description needs simplifying for the general practitioner, in spite of the fact that this reaction is in essence only a quantitative chemical test for the presence of "complement." Psycho-analysis finds a short place in the text-book; it is described as a "time-robbing task," and the author shows a dignified reserve in its discussion, merely indicating briefly the methods employed to carry it out. Figures of the dead neuron (Betz cells) are introduced from the drawings of Adolf Meyer, but no reference is made to the altogether different structure of the living neuron. On the whole, the manual is a trustworthy text-book for the psychiatric clinic, and the new edition brings the work fairly up to date, although there is no mention of "shell-shock" or the mental effects of the war. Probably the recent development in American politics will soon remedy this defect.

ROBERT ARMSTRONG-JONES.

PHILOSOPHY AND PARADOX.

(1) *Fermat's Last Theorem.* By M. Cashmore. Pp. 63. (London: G. Bell and Sons, Ltd., 1916.) Price 2s. net.

(2) *The Elements of Non-Euclidean Plane Geometry and Trigonometry.* By Prof. H. S. Carslaw. Pp. xii+179. (London: Longmans, Green and Co., 1916.) Price 5s. net.

(3) *The Algebraic Theory of Modular Systems.* By F. S. Macaulay. Pp. xiv+112. (London: At the Cambridge University Press, 1916.) Price 4s. 6d. net.

(1) THE main fallacy of Mr. Cashmore's paradoxical tract is this:—"Let f, ϕ be polynomials in x, and λ a constant different from zero; then, if f, ϕ have a common factor $(x-\alpha)$, $x=\alpha$ may be regarded as a solution of $f/\phi=\lambda$. *Conversely*, if $f/\phi=\lambda$ has a root α, then $(x-\alpha)$ must be a common factor of f and ϕ." (See p. 18.)

(2) By this time it is fairly well known among mathematicians that ordinary geometry is a sort of border-line between two equally consistent theories, in each of which Euclid's axiom of parallels is false. In one of these the sum of the angles of a "rectilinear" triangle exceeds two "right" angles; in the other it falls short of it, and may even converge to zero. If "similar" triangles are defined by parallelism of sides, we have the sums of their angles differing according to a fixed law; and, similarly, if we define them by proportion of sides (generally according to a different law). These non-Euclidean geometries apply to three-dimensional space as well as to the plane, and the question for teachers is to make them intelligible to the student by intuitional methods. As regards the case when the sum of the angles of a triangle is less than two right angles, nothing can be better than to take as

"straight lines" circles which cut a fixed ordinary sphere orthogonally, and to regard all points outside this sphere either as non-existent or as "images" of accessible points within the sphere. The *plane* version of this is given by Prof. Carslaw (pp. 153–75) in the clearest manner conceivable; but he does not seem (in this book) to have considered the analogous theory *in solido*. There is no satisfactory theory of three-dimensional non-Euclidean geometry, *from an intuitional point of view,* unless it gives us a clear three-dimensional image in our ordinary space, assuming, of course, that our powers of "intuition" are confined to ordinary space.

One of the great merits of Prof. Carslaw's book is that he gives a good account of the history of the subject. In a certain sense Saccheri is the great pioneer, and as much justice seems to be done to him as the scope of the work permits. The next is presumably Gauss, but, as usual, he lost his claim by delay in publication.

It should be noticed that theories of parallels and theories of distance are, or may be made, essentially distinct. Thus, if we define *parallel* lines as those which cut the fundamental sphere orthogonally in the same point, they may or may not be continually at the same *distance* from each other, according as we define the measure of the distance of two parallel lines.

Altogether, we think Prof. Carslaw's book is one of the best introductions to the subject that we have seen. He ought to have given a reference to Mr. Somerville's bibliography.

(3) Let $F_1, F_2, \ldots F_n$ be n assigned polynomials in m variables; then $[F_1, F_2, \ldots F_n]$ is defined to be the set of polynomials $X_1F_1+X_2F_2+ \ldots +X_nF_n$, where X_1, X_2, $\ldots X_n$ are arbitrary polynomials in the same variables. We also speak of $[F_1, F_2, \ldots F_n]$ as a "modulus" or "module," this term being due to Kronecker, who first emphasised the importance of *algebraical* moduli. The importance of *arithmetical* moduli, in the wider sense, was discovered by Dedekind, and the whole theory of algebraic integers in a given field may be reduced to that of moduli *contained in that field.* The algebraic theory is analogous, but much more difficult, and Dr. Macaulay has done a real service to mathematics by his original and critical tract. Even men such as Kronecker and Lasker seem to have made mistakes (in detail) in this peculiarly difficult field of research.

The originality and conscientiousness of this tract are so great that the reader must forgive the author for occasional obscurities. For instance, the "array" on p. 7 is fundamental, but we fear that many readers may fail to see precisely what it means, and the "reverse" notation (p. 4) for F_1, F_2 is not justified by any remark in the text.

The main result, illustrated by well-chosen examples, is that whereas, in the arithmetical theory, a modulus is uniquely expressible as a product of prime moduli, and all moduli are, so to speak, homogeneous in the sense that numbers of the natural scale are homogeneous, the same is *not* true of algebraic moduli in general, and we have to introduce technical epithets to distinguish one kind of modulus from another. In fact, it seems clear that the problem of classifying algebraic moduli according to their essential properties is at least as complicated as the corresponding problem in group-theory; and if we attend to the arithmetical nature of the coefficients (*e.g.* if, instead of taking them as *umbrae,* we take them as integers in a given finite field), additional difficulties present themselves. We hope that Dr. Macaulay will continue his researches; meanwhile this tract ought to be welcomed as one of the most valuable in the series to which it belongs.

G. B. M.

SOME ASPECTS OF TEXTILE MANUFACTURE.

Dyeing in Germany and America, with Notes on Colour Production. By S. H. Higgins. Second edition, rewritten and enlarged. Pp. viii+143. (Manchester: At the University Press; London: Longmans, Green, and Co., 1916.) Price 5*s.* net.

THE first edition of this book was reviewed in NATURE for November 7, 1907. Since the completion of his work as a Travelling Scholar under the Gartside Foundation scheme, the author has gained much practical experience in dye and bleach works, the results of which are embodied in the new volume. This has added considerably to its value, particularly in the sections dealing with mercerisation and bleaching.

In a new chapter the German and English methods of manufacturing flannelettes are contrasted. This is of interest as raising the general question of the relative efficiency of the British and German methods of textile manufacture. Generalisation on such a topic is, of course, open to many pitfalls, and an adequate discussion of the matter would be impossible in this review; but, broadly speaking, the British textile industry has developed along the lines of specialisation of *processes,* whilst the German specialises in *products.* This contrast is seen very acutely in the worsted industry, in which it is quite usual here for at least five distinct firms to be concerned in the production of a piece of cloth—the comber, the spinner, the weaver, the dyer and finisher, and the merchant. Each of these carries out its section of the work with the maximum amount of skill and at the minimum cost, but there is an obvious, and very real, danger that the various processes are not sufficiently co-ordinated. On the other hand, the usual German practice is to carry out all processes in one works and under one general control, when it is much easier to correlate the various stages of manufacture and subordinate each process to the final result desired. The ultimate aim should be to combine the advantages of both systems.

The author of the book has also added a new chapter on "Instruction in Dyeing," and gives it

as his opinion, after inspecting the dyeing schools in Germany, Austria, and the United States, that they are not to be compared, as regards equipment or efficiency, with the schools at Manchester, Bradford, and Leeds. This is true enough, but is not generally recognised.

With regard to trade research, it is pointed out that the amount actually carried on must not be gauged by publications in technical journals. The most valuable results obtained are, of course, used by individual firms, and it is only gradually that they become known and find a place in the literature. This is no argument against the many schemes of research initiated by industries as a whole. It is often stated that information which is the common property of an industry is of no special value to an individual firm; but this is a fallacy, as it is in *applying* new information in particular directions that individual enterprise, skill, or special facilities have full scope.

The new edition of the book has been largely rewritten throughout, with great advantage. The concluding section deals with the future prospects of the dye-manufacturing industries in Britain, France, and the United States. W. M. G.

OUR BOOKSHELF.

An Introduction to a Biology, and Other Papers. By A. D. Darbishire. Pp. xviii+291. (London: Cassell and Co., Ltd., 1917.) Price 7*s*. 6*d*. net.

Since the advent of natural selection the mechanistic interpretation of Nature has on the whole steadily gained ground among biologists. The trend has been more and more towards the translation of vital phenomena in terms of physics and chemistry. Much of modern investigation, such as the discovery of artificial parthenogenesis or the establishing of the Mendelian principles among the phenomena of heredity, has undoubtedly strengthened the mechanistic position. Yet to all action succeeds reaction. To-day there is an evident tendency in many quarters to cast on one side the mechanistic interpreter and seek out other prophets. The note sounded thirty years ago by the acute and critical intellect of Samuel Butler is finding echoes among biological workers. Such a one was the author of this book. The "Introduction to a Biology" was designed, we are told, to direct attention to the failure of modern interpretative biology and to suggest the direction in which an understanding of life may be sought. Unhappily the work is but a fragment cut short by the author's premature death.

The principal theme is that the intelligence of man is of utilitarian origin, developing gradually as he gradually acquired more and more control over his material surroundings. Hence the circumstances of its development have led to man's welcoming a mechanistic theory of the organism and a materialistic theory of evolution to the neglect of other points of view. The influence of Bergson is clearly marked not only in the thesis, but in the generous use of entertaining analogy.

The essay, however unconvincing, is brightly written, for the author had a style of candid freshness and a gift of investing even trivial things with humorous interest. The charm of his personality is well brought out in the brief biographical sketch by his sister, upon whom fell the labour of piecing together what he left behind. It should be added that the greater part of the book consists of Darbishire's papers reprinted from various sources.

The Secretion of the Urine. By Prof. A. R. Cushny. ("Monographs on Physiology.") Pp. xi+241. (London: Longmans, Green, and Co., 1917.) Price 9*s*. net.

In this extremely valuable monograph Prof. Cushny gives an admirable account of the kidney, and discusses the various views held as to its functions. Many other matters, such as the action of drugs upon it and the changes that occur in disease, are included, and the bibliography appended is of a most complete kind. The centre of interest in the book, however, is the presentation of the author's own views on the theory of kidney activity. The main theories discussed are naturally those associated with the historic names of Bowman and Ludwig. Bowman's view, with modifications introduced by Heidenhain and others, is at the present time the one most favoured by the majority of physiologists; Prof. Cushny's view, which he terms the "modern view," is a modified Ludwig hypothesis: secretion (a pure filtration) occurs at the glomerulus, and this fluid is converted into more concentrated urine by reabsorption which takes place in the tubules.

The author criticises the Bowman-Heidenhain theory that secretion of urea, etc., occurs in the tubules, partly because he interprets Heidenhain's celebrated pigment experiments in a new way, but mainly because it is vitalistic. His own theory reduces the "kidney to a machine," instead of postulating for it the capacity of a trained analytical chemist. It is a little difficult to follow the author here, for in some pages the reabsorption which he supposes to occur is spoken of as being indiscriminate and mechanical, while in other places he speaks of the kidney-cells as rejecting the urea instead of reabsorbing it, and in one place at least (p. 44) he says that reabsorption depends on the *vital activity* of the epithelium, and in so doing drops into an expression which is anathema to him as a rule. It really does not matter what word we employ—secretory, selective, or vital; but by whichever name we call it, selective action is undoubted in the case of other secretions, and in the kidney, whether the substances pass through its cells in one direction or the other, the cells do exercise discrimination. Prof. Cushny argues that discrimination implies intelligence; he might just as well urge that the amœba is intelligent because it rejects non-nutritious particles.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Letter of Ch. Darwin in Argentina.

ON the occasion of the first national meeting of the Sociedad Argentina de Ciencias Naturales, held towards the end of last year in the city of Tucuman, Señor Juan W. Gez presented the archive of Dr. F. J. Muñiz, together with a biographical narrative. To that archive belongs the subjoined letter from Darwin which I have transcribed. That letter, as can be seen, has not been included in the "Life and Letters of Ch. Darwin," but a Spanish version of it was published by the first biographer and editor of the papers of Dr. Muñiz—Don Domingo F. Sarmiento,[1] ex-President of this Republic (1868–74).

I would first, in a few words, say something concerning the man himself, who is probably little known to the English public. Dr. Francisco Javier Muñiz is considered to be the first Argentine naturalist. He was born in San Isidro in the year 1795. In 1821 he had already graduated in medicine, and was located for four years in Carmen-de-Patagones as a military doctor, at a time when those regions were still inhabited by Indians. From that period dated his inclination and fondness for natural sciences. From the year 1825 he resided in the province of Buenos Aires, where he rendered medical services, eventually coming to be professor, and later dean, of the faculty of medicine of the city of Buenos Aires. At the age of seventy years he continued to serve in his professional capacity as military physician, through the long war which Argentina, together with Brazil and Uruguay, waged against the tyrant Lopez, of Paraguay. In 1871, when the terrible epidemic of yellow fever scourged the city of Buenos Aires, he wished even at his advanced age to lend his professional services, but himself succumbed a victim to the disease on October 8 of the same year, at seventy-six years of age. The city of Buenos Aires has raised a monument to his memory.

The scientific works carried out by Muñiz treated of medicine and natural sciences, as may be seen by Darwin's letter. He was the first one in the Argentine to devote effort to collecting and studying the remains of the fossil mammals, which have since made famous the Pampa regions. As a physician he knew anatomy well, but his attainments in comparative osteology were less solid, because of the lack of works of study, which were exceedingly difficult to obtain at that time in this country.

Dr. Muñiz discovered numerous fossil mammals, and described some of them. Among these was the great fossil tiger of the Pampas, which he called *Felis bonaërensis* (see *La Gaceta Mercantil*, Buenos Aires, October 9, 1845). Not being familiar with the usages of nomenclature, he thought the suggestion of some friends acceptable, and that he should call the fossil Muñi-felis, but he only used this name once in the title, while in the description he simply calls it *Felis bonaërensis*, this being a less objectionable denomination. Notwithstanding, had the species been really new, his name should have continued, but it turned out to be, not a Machærodus, as Darwin suggested, but a Smilodon, distinct from the *S. neogaeus*, Lund, and which should bear the name *S. bonaërensis*, Muñiz, Amegh. With reference to the purpose declared by Darwin of having Dr. Muñiz's description translated and published (a description which was very prolix and detailed), it would seem that this was never carried out.

The reports on the *ñata* cow (a type of short-faced, wide-nostriled cow), to which Darwin refers, are those which are mentioned in his "Journal of Researches" (p. 146, second edition, 1845); but the series of questions to which Muñiz replied, and a copy of which I now find in the above-mentioned archive, contains many other details of interest which Darwin did not utilise, and Sarmiento did not publish save in very fragmentary form. These data have therefore undoubted interest, now that, as one may say, the peculiar *ñata* cow belongs to history.

The collection of fossil bones from the Pampa of which Darwin speaks from references by Owen is probably that which Muñiz gave to General Rosas in 1842, and Rosas gave to some French personage who resided in Buenos Aires, who in his turn presented it to the Paris Museum.

In conclusion, I may say that the projected sale of the rest of his collections, of which Muñiz spoke to Darwin, had not, as some might think, any commercial end in view. Muñiz proposed by this sale to obtain some resources for the sole purpose of being thus able to prosecute his explorations in the search for fossils, as appears from copies of letters preserved in his archive. The last specimens of his collection were presented by him to the Museum of Buenos Aires.

Subjoined is the text of Darwin's letter.

M. DOELLO-JURADO.

Museo Nacional, Buenos Aires, April, 1917.

Down, Farnborough, Kent,
February 26, 1847.

Dr. F. J. MUNIZ, Buenos Aires.

RESPECTED SIR,

Your letter of August 30, with the papers which you were so good as to send me, reached me only a short time since, owing to the protracted illness and absence from London of Mr. Morris, through whom they were sent. I have lately heard from Mr. Morris that you wish to dispose of your fossil remains on some pecuniary arrangement, which I did not fully understand from your own letter to me. I have given Mr. Morris my opinion on this head, so will not here repeat it; but will only say that I conceive the only feasible plan would be to send your fossils here to some agent to dispose of them. No society will purchase anything of the kind without having them inspected, and most societies only receive presents. Your specimen of the Muñi-felis must be a noble one; I suspect it will turn out to be a Machairodus, of which there are some fragments in the British Museum from the Pampas. I will endeavour to get your paper translated and inserted in some scientific periodical. Your account of the earthquake in the Pampas has surprised me; I never heard of one in any part further east of the Cordillera than at Cordoba. If you will inform me whether you read English I shall be happy to send you a copy (if you will point out some channel) of my "Geological Observations on South America," lately published; I do not think it worth sending them without knowing whether you read English, which I fear is not probable. Your pamphlet on the scarlet fever I will present to the Royal College of Surgeons.

I cannot adequately say how much I admire your continued zeal, situated as you are without means of pursuing your scientific studies and without people to sympathise with you, for the advancement of natural

[1] "Life and Writings of Col. Francisco Javier Muñiz," p. 280 (Spanish) (Buenos Aires, 1885.)

history; I trust that the pleasure of your pursuits affords you some reward for your exertions. Some time since you were so kind as to send me through Mr. E. Lumb some *most curious*, and to me *most valuable*, information regarding the Niata oxen. I should be deeply obliged by any further facts about any of the *domestic* animals of La Plata; on the origin of any "breed" of poultry, pigs, dogs, cattle, etc. I should be much interested by a brief description of the habits and appearance of the pigs, dogs, etc., which have *run wild*, and especially on the habits of these wild breeds, when their young are caught and reared. Will a puppy of one of the run-wild dogs, if brought up carefully, be as tame as a common dog? *Any* information on *all* such points would be of *real service* to me; and my address, should you find time to write to me, will always be that at the head of this letter. I most sincerely wish you all success in your admirable labours, and if at any time I can be of any service, I shall be happy to be so; but I am sorry to say I am not connected with any mercantile establishment and cannot recommend agents, etc., etc.

With much respect, I beg to remain, Sir,

Your obliged and obedient servant,

Charles Darwin.

P.S.—I omitted to state that Prof. Owen has heard that a collection of bones from Buenos Aires some time since arrived at Paris.

Plated Teeth of Sheep.

Plating of the teeth of sheep with "gold" can scarcely have been a common phenomenon, in Scotland at any rate, for in the few cases mentioned by the older writers it is recorded as something of a marvel.

In 1536 Hector Boece, Bishop of Aberdeen, thus described the sheep of Doundore (Bellenden's translation):—"In Gareoth [Garioch, a district of central Aberdeenshire] is ane hill namit Doundore, that is to say, the Goldin Montane. The scheip that gangis on this montane ar yallo; thair teeth are hewit like gold; thair flesche reid, as it wer littit with safron; thair woll is on the same maner." This locality remained for a couple of hundred years the typical Scottish locality, if one may so call it, for golden-toothed sheep, for it is mentioned by many writers, whose accounts vary mainly in the spelling of the hill-name —Dundore, Dunedere, Dinnedure, etc. It is the prominent conical, ruin-capped hill, still known as Dunnideer, near the railway station of Insch, in central Aberdeenshire.

Martin, in his "Description of the Western Islands of Scotland" (1703), almost suggests that the colouring of the teeth in the Outer Hebrides is due to native gold in the soil:—"The Natives affirm that Gold Dust has been found at *Griminis* on the Western Coast of the Isle of *North Uist*, and at *Copveaul* in *Harries*; in which, as in other parts of the Isles, the teeth of the Sheep which feed there are died yellow."

In these cases it is likely that iron in fair quantity was present in solution in the bogs and streams, for Dunnideer is formed of a cap of coarsely grained syenite lying upon the basic intrusive mass of the district, which possesses a moderate ferro-magnesian content, while the peat-bogs characteristic of the Outer Hebrides rest upon Lewesian gneiss, the ferruginous tendency of which in the area is indicated by the presence of patches of hornblende and garnet. In the Aberdeenshire area, iron pyrites, also, is disseminated throughout the intrusive mass in microscopic crystals.

James Ritchie.

Edinburgh, June 7.

The Organisation of Scientific Literature.

In the current number (June, 1917) of *Scientia* (pp. 530–32) there is a somewhat full account of discussions that took place at the meeting of the Italian Society for the Advancement of Sciences at Milan in April last, which are of great interest to us, particularly at the present time. Prof. Gino Loria spoke about national and international collaboration in publications on science and culture, and Prof. Eugenio Rignano spoke on projected scientific periodicals of the Entente. The praiseworthy scheme of Prof. Rignano was fully described by him in a letter printed in Nature of January 25 of this year, and I may also refer here to an article by myself on the organisation of scientific literature in *Science Progress* for last April. It is necessary that the nations of the Entente should take immediate steps to make themselves less dependent on Germany for the results of organisation of scientific and philosophical literature, if for no other reason than that Germany's powers of production are very much lessened at present, and probably will be even more so in future. Science is, of course, not an affair merely of particular nations or groups of nations; all nations should combine to make the work of advance in science rather easier by organising its literary aids. It seems that we, in particular of all nations, ought not to remain content with the position into which we have fallen in this possibly humble organising duty of science. I may remark that I have been in correspondence with the Government with respect to plans for Government action in this direction, and that, though some outcome of the correspondence does not seem impossible, it is to be feared that the curse of delay will act as a clog on the wheels of progress. One would have thought that by now the evils of inefficiency, slackness, and neglect of science had been sufficiently forced upon us. In France, Italy, and America there have been public expressions of a wish to help in this need for the organisation of the literature of scientific research.

Philip E. B. Jourdain.

The Bourne, Basingbourne Road,
Fleet, Hants, June 2.

The Origin of Flint.

Sir E. Ray Lankester (Nature, June 7, p. 283) attributes the black colour of flint to carbon, but has he considered whether ferrosoferric oxide may be the cause of the colour?

I have recently observed a similar, almost black colour in specimens of hydrated, colloidal sodium silicate, which contained small quantities of oxide of iron, originally in the ferrous state, but partly oxidised.

It has been pointed out by Hofmann and Resenscheck (*Annalen*, 1905, vol. cccxlii., p. 364) that depth of colour in various chemical compounds is connected with the presence within the same molecule of atoms of an element exercising two different valencies. The deep colours of sulphur sesquioxide and uranouranic oxide are examples of this phenomenon, and especially the deep blue colour of ferric ferrocyanide. The dark colour of hydrated, ferrosoferric oxide is well seen when white, ferrous hydroxide, precipitated by alkali from ferrous sulphate solution, undergoes atmospheric oxidation, or when a mixed solution of ferrous and ferric salts is similarly precipitated. The greenish-black colour, which cannot possibly be due to a mixture of white, ferrous hydroxide and reddish-brown, ferric hydroxide, is to be attributed to a compound of the two hydrated oxides.

R. M. Caven.

University College, Nottingham, June 11.

THE SOCIETY OF CHEMICAL INDUSTRY AND THE PROGRESS OF THE CHEMICAL ARTS.

THE Society of Chemical Industry has done wisely in following the example of the Chemical Society in initiating the compilation and issue of annual reports on the progress of the various sections of applied chemistry dealt with in its journal. Its action is most opportune, for there can be no question that such a publication, if well and judiciously carried out, will have a profound effect on the development of that branch of technology which it is the special function of the society to foster. Valuable as the present volume undoubtedly is, we venture to think it furnishes only a partial indication of what such a work, if loyally supported, is destined to become. It would not be fair to its projectors to infer its ultimate character from the issue before us. It is confessedly incomplete, and covers only a portion of the sections of the classification followed in the society's journal. This has, no doubt, arisen from the circumstance that many of those best qualified to report on the missing sections have, owing to the special conditions of the time, been wholly engaged upon more pressing occupations. Indeed, this circumstance has probably reacted upon the production of the work generally, and is a sufficient explanation of its somewhat belated appearance. It was a bold venture to carry out such an undertaking in circumstances so unpropitious, and the editor and the Publication Committee are to be congratulated on the measure of success that has attended their efforts under such untoward conditions.

In addition to the missing reports on fibres, dyeing, metallurgy, electro-chemistry, and sugar, to which the preface refers, and to that on explosives, which for obvious reasons it is undesirable to include at the present time, no action has been taken in respect to agricultural chemistry, the chemistry of foods, and analysis, ostensibly on the ground that these subjects are dealt with in the annual reports issued by the Chemical Society. This appears to us no valid reason for their future exclusion. As these sections are part of the fortnightly issue of the society's journal, they presumably meet a want, and are acceptable to a more or less considerable fraction of its readers. If so, these readers are equally entitled, and may fairly look forward, to the annual summaries of progress and development in these sections as well as in the others. Moreover, it must not be forgotten that the compilers and readers of each of the two annual reports look at the subjects from somewhat different points of view. One set is primarily concerned with abstract and theoretical principles, the other with practical application. Of course, it is not possible to draw any hard-and-fast line between them, as each is intimately related to the other. But as the angle of view is certainly different, there is surely room for both, and it would unquestionably tend to efficiency and comprehensiveness if the council of the society decides that in future its annual reports of progress should include every department of applied chemistry with which its journal is concerned.

The present volume is made up of reports on fifteen out of the twenty-three sections of the classification adopted in the society's journal, and thirteen contributors, together with the editor, Mr. Burton, have been engaged in its production. Each author is well qualified to treat of the section which has been entrusted to him. Thus Prof. Cobb, the Livesey professor of fuel and gas industries of Leeds University, deals with "Fuel and Heating" and with "Mineral Oils"; Mr. E. V. Evans, the chief chemist of the South Metropolitan Gas Company, reports on "Gas: Destructive Distillation: Tar Products"; Prof. Gilbert Morgan writes on "Colouring Matters and Dyes"; Dr. Auden, of the United Alkali Company, on "Acids, Alkalis, Salt, etc."; Mr. Audley on "Glass and Ceramics" and "Building Materials"; Mr. Warburton, who was associated with the late Dr. Lewkowitsch, on "Oils, Fats, and Waxes"; Dr. Morrell, of Messrs. Mander Bros., on "Paints, Pigments, Varnishes, and Resins"; Dr. Stevens on "India-rubber"; Mr. Joseph T. Wood, of Messrs. Turner Bros., Ltd., on "Leather and Glue"; Mr. Arthur Ling, the chairman of the London section of the society and the editor of the Journal of the Institute of Brewing, reports on the "Fermentation Industries"; Mr. O'Shaughnessy on "Water Purification and Sanitation"; Dr. Pyman, director of the Wellcome Research Laboratories, on "Fine Chemicals, Medicinal Substances, and Essential Oils"; and Mr. B. V. Storr, of the Ilford Company, on "Photographic Materials and Processes." Such names, with such connections, are well calculated to inspire confidence in the judgment, knowledge, and critical ability with which the reports have been compiled.

Of course, it would be impossible in the space at our disposal to enter into any detailed analysis of these several communications, or to show at any length in what respects they fulfil, or fail in, their purpose of being "the abstracts and brief chronicles of the time." As is to be expected, much of the subject-matter is too technical to be of general interest. But in certain of their aspects these reports are highly significant, and the story they tell is of national importance. As might have been anticipated, the authors have not been able, however much they might have wished, to get away from the war. That stupendous event is profoundly influencing the position of chemical industry in this country, and anyone who deals with its present condition and prospective development cannot possibly ignore that fact if he rightly interprets his duty as a chronicler.

It is therefore of interest to ascertain what, in the judgment of experts, has been the effect of the war on the several branches of applied chemistry in this country, and how far that effect is likely to result in a general and permanent improvement in their character. It may be thought too soon to pronounce any definite

opinion on this matter, and this may have led certain of the contributors to hesitate in giving it. Others, however, have been able to read more clearly the signs and portents of the times, and, on the whole, their testimony is reassuring and full of hope. There can be no doubt whatever that the general body of chemical manufacturers in this country, as well as of the manufacturers dependent on chemical industry, have had a rude awakening. The war has completely upset commercial conditions, and many generations must come and go and a long period of peace ensue before pre-war relations are resumed. Public sentiment will force this country to depend more and more upon its own efforts, and to develop to a far greater extent its own internal resources. There is a general recognition that at the base of this problem is our educational system, and we see the evidence of this fact in the appointment of a professed educationist as director of a new policy. It is being realised that science and the methods of science must enter more largely into the curriculum of our secondary schools, and that colleges of science must be multiplied and strengthened. It is now everywhere perceived that the future of all industries depends upon science and upon the application of scientific principles. The bread that has been cast upon the waters is now being found after many days.

Many proofs of this fact are to be met with in the volume before us, accompanied, we regret to add, with certain disquieting features. There are those who aim at ends which are not those of their country, and too many new activities are secret. Perhaps in the circumstances this is unavoidable; but, as the example of our enemies has shown us, those industries flourish best and develop most rapidly where their leaders co-operate for their common good, even though they may themselves combine *contra mundum*.

Progress in applied chemistry may be measured by different standards. From an economic point of view it may be estimated by the wealth it brings to a community. This aspect of the matter finds practically no mention in the compilation before us. It is probably difficult to get together the requisite information, but if the Society of Chemical Industry could be induced to add a statistical department to its staff and publish the results of its labours each year as a supplement to these annual reports, we should obtain a real and valuable measure of the progress of the chemical arts in this country. As it is, the present work is too obviously based upon the pattern of the annual reports published by the Chemical Society, and is too exclusively a *catalogue raisonné* of the yearly output of the literature of applied chemistry. We would by no means undervalue the worth of such a compilation, but we venture to believe a fuller measure of its usefulness might be secured by a further extension of its scope.

These observations are offered in no spirit of carping criticism. We welcome with sincere pleasure the advent of an enterprise which is bound to have a far-reaching influence on the development of chemical industry in all English-speaking countries. Its inception at the present juncture is most timely, and we heartily wish it success. Thanks to the energy, skill, and perspicacity with which it is conducted, the journal of the society has become its most valuable asset. We are confident that these annual reports are destined to be a no less valuable feature of its work, provided that those who control its affairs are determined to rise to the full extent of their opportunity.

THE RADIATION OF THE STARS.

SINCE the publication of Homer Lane's paper "On the Theoretical Temperature of the Sun" in 1870, many writers have discussed the internal state of a star, considered as a globe of gas in equilibrium under its own gravitation. Recent observational work gives encouragement to these investigations, for it is now known that numerous stars are in a truly gaseous condition with mean densities similar to that of our atmosphere. To such stars the results for a perfect gas may fairly be applied, whereas stars, such as the sun, with densities greater than water must necessarily deviate widely from the theoretical conditions. The stars which are in a perfectly gaseous state correspond to the "giants" on H. N. Russell's theory,[1] or to the stars of rising temperature on Lockyer's principle of classification; the denser "dwarfs" are outside the scope of this discussion. The two series coalesce for spectral type B, which marks the highest temperature attained.

The internal temperatures which have been calculated are so far beyond practical experience that we may well hesitate to apply the familiar laws of physics to such conditions. But in so far as the investigation can be based on the second law of thermodynamics, the conservation of momentum, or laws which are directly deduced from these, there can be little doubt of the validity of the treatment. We cannot altogether avoid assumptions of a speculative or approximate character, and no doubt some of the results described in this article are open to serious criticism on that account; but to a considerable extent the discussion can be made to rest on laws which are held to be of universal application. Moreover, natural phenomena usually become simpler at high temperatures; gases become more "perfect"; the absorption of X-rays follows simpler laws than the absorption of light; the heat-energy comes to be located in greater proportion in the ether, so that the precise nature of the material atoms is less important.

Most investigators have assumed that the stars are in convective equilibrium.[2] In that case, when

[1] NATURE, vol. xciii., pp. 227, 252, and 281.

[2] There are strong reasons for believing that the interior of a star must be in radiative equilibrium, not convective equilibrium. The internal distribution of temperature and density is, however, of the same character in either case; if the coefficient of absorption is independent of the temperature, then the distribution corresponding to radiative equilibrium is the same as that of material for which $\gamma=\frac{4}{3}$ in convective equilibrium. See *Monthly Notices, R.A.S.*, vol. lxxvii., p. 16.

the mass and mean density are given, and also the molecular weight and ratio of specific heats (γ) of the material, we can find at once the temperature at any internal point. Let us take a star of mass $1\frac{1}{2}$ times that of the sun and of mean density 0·002 gm./cm.^{3}; for illustration, the average molecular weight will be taken as 54 (*e.g.* iron vapour dissociated into atoms at the high temperature). For γ we shall take $\frac{4}{3}$, but any possible change in γ makes comparatively little difference in the results, so far as we require them. For this star the calculated temperature at the centre is 150,000,000°; half-way from the centre to the boundary it is 42,000,000°. But the temperature of which we have some observational knowledge is not given immediately by these calculations; according to observation, the "effective temperature" of a star of this density would probably be about 6500°. This term does not refer to the temperature at any particular point, but measures the total outflow of heat per unit surface. Now, the outflow of heat evidently depends on two conditions—the temperature gradient (more strictly the gradient of T^4), and the transparency of the material; therefore, the temperature-distribution being calculated as already explained, we can deduce the transparency necessary to give the observed effective temperature of 6500°. The result is startling. We find the material must be so absorbent that a thickness of one-hundredth of a millimetre (at atmospheric density) would be almost perfectly opaque. There is little doubt that such opacity is impossible. Conversely, if we adopt any reasonable absorption coefficient, the effective temperature would have to be above 100,000°, which is decisively contradicted by observation.

A way out of this discrepancy is found if we take into account the effect of the pressure of radiation. Fortunately, this effect can be calculated rigorously without introducing any additional assumption or hypothesis. Suppose that a beam of radiation carrying energy E falls on a sheet of material which absorbs kE and transmits $(1-k)$E. It is known from the theory of electromagnetic waves that radiant energy E carries a forward-momentum E/c, where c is the velocity of light; similarly, the emergent beam carries momentum $(1-k)E/c$. The difference kE/c cannot be lost, and must evidently remain in the absorbing material. The material thus gains momentum, or, in other words, experiences a pressure. The amount of the pressure kE/c involves the coefficient of absorption k, of which we have no immediate observational knowledge; but it is the *same* coefficient which has already entered into the calculations of the opacity of the material, so that the introduction of radiation-pressure into the theory brings in no additional unknowns or arbitrary quantities.

The radiation-pressure is thus proportional to k, and to the approximately known outflow of energy. The preposterous value of k already found would, if adopted, lead to a pressure far exceeding gravity, so that the star would be blown to pieces. But the radiation-pressure modifies the internal distribution of pressure and temperature; it supports some of the weight of the outer layers of the star, and consequently a lower temperature will suffice to maintain the given density. The smaller temperature-gradient causes less tendency to outflow of heat, and there is accordingly no need for so high an opacity to oppose it. By calculation we find that for a star of mass 1·5 times the sun, and molecular weight 54, radiation-pressure will counterbalance 19/20ths of gravity; somewhat unexpectedly, this fraction depends neither on the density of the star (so long as it is a perfect gas) nor on the effective temperature, but it alters a little with the mass of the star. The pressures and temperatures are then reduced throughout in the ratio 1/20; for the star already considered, the corrected value of the central temperature is 7,000,000°. Assuming an effective temperature of 6500°, we can now calculate the new value of k; it amounts to 30 C.G.S. units, *i.e.* 1/30 gm. per sq. cm. section will reduce the radiation passing through it in the ratio $1/e$. It is of considerable interest to note that this is of the same order of magnitude as the absorption of X-rays by solid material; for at the high temperatures here concerned the radiation would be of very short wave-length and of the nature of soft X-rays.

The approximate balance between radiation-pressure and gravity leads to an important relation between stellar temperatures and densities. It is easy to put this relation in a more rigorous form; but it will suffice here to express the condition as radiation-pressure = gravity. If T is the effective temperature of the star, and g the value of gravity at the surface, the outflow of radiation (per unit area) varies as T^4, and the condition is

$$kT^4 \propto g.$$

We shall assume that k is the same for all stars. Now g depends on the mass and mean density in the ratio $M\rho^{\frac{1}{3}}$. Hence

$$T \propto M^{\frac{1}{12}}\rho^{\frac{1}{6}}.$$

The range of mass in different stars is trifling compared with the great range of density. Thus the leading result is that *the effective temperature of a giant star is proportional to the sixth-root of the density.* To test this, we take the densities given by Russell[3] for the different types, and, assuming that stars of the solar type (G) have the sun's effective temperature (6000°), we calculate by the sixth-root law the temperatures of the other types.

Type	Density (☉=1)	Effective temperature
A	$\frac{1}{10}$	10,800°
G	$\frac{1}{350}$	6,000°
K	$\frac{1}{2800}$	4,250°
M	$\frac{1}{25000}$	2,950°

The calculated numbers in the last column agree almost exactly with the temperatures usually

[3] *Loc. cit.*, pp. 282–83.

assigned to these types, and it is clear that if Russell's densities are correct the sixth-root law must be close to the truth.

If a is the radius of a star the total radiation will be proportional to a^2T^4, which varies as ga^2, *i.e.* as M. The total radiation thus depends only on the mass, and not on the density or stage of evolution. The absolute luminosity is a fairly good measure of the total radiation for the range of temperature here considered, though, of course, the visibility of the radiation changes a little with the temperature. We shall thus have the total radiation constant as we pass through the series of spectral types, and the luminosity roughly constant (with deviations amounting to about $1\frac{1}{2}$ magnitudes). This is just the feature which Russell has pointed out in the luminosities of the giant stars; they are practically the same whatever the type of spectrum.[4]

It may be remarked that this theory avoids a difficulty noticed by J. Perry[5], that when γ is less than $\frac{4}{3}$, the heat within the contracting star is greater than the energy set free by contraction, leaving less than nothing for radiation into space; the difficulty is even more serious than Perry considered, for he did not make any allowance for the enormous store of ethereal energy necessary for equilibrium with matter at high temperatures. But we have seen that by taking account of radiation-pressure the interior temperature is much reduced; less internal heat is therefore needed; and there is, in fact, an ample balance of energy left for dissipation even when γ is considerably below $\frac{4}{3}$.

With a molecular weight smaller than 54 the importance of radiation-pressure is reduced; for example, with molecular weight 18 radiation-pressure is 6/7 of gravity, instead of 19/20. But it still plays a predominant part until we come down to molecular weight 2. Reasons have been urged in favour of a low average molecular weight—perhaps as low as 2. It is probable that the atoms are highly ionised by the radiation of short wave-length within the star; and if most of the electrons outside the nucleus are split off from each atom we shall actually have an average weight for the ultimate independent particles nearly equal to 2, whatever the material (excluding hydrogen). Radiation-pressure is then less than half gravity; but the two principal laws, which seem to be verified by observation, are arrived at as before. Moreover, the order of magnitude of k is scarcely altered; it is now 5 instead of 30 C.G.S. units. Nor is the internal temperature much changed. In fact, the effect of ionising the atoms is that the pressure of the superincumbent layers is supported by a mixture of cathode rays and X-rays, instead of by X-rays alone; our doubt as to the proportions in which these occur and as to which will predominate is no serious hindrance, because the main results are nearly the same in any case.

A. S. EDDINGTON.

[4] *Loc. cit.*, p. 252, Figs. 1, 2, and 3.
[5] NATURE, vol. lx., p. 350.

DR. W. H. BESANT, F.R.S.

THE death of William Henry Besant on June 2, in his eighty-ninth year, will be mourned, in all sincerity, by a far greater number than he would have anticipated, supposing that he ever wasted a thought on the subject. Among these will be a legion of his old pupils, who had the opportunity of learning to know him in a peculiarly intimate way. Until 1880 or so Besant and Routh had almost a monopoly, for many years, in coaching pupils for the Mathematical Tripos. Besant's method was rather odd, but very effective with the right sort of man. At the cost of immense labour he had written out, with his own hand, a set of "bookwork and rider" papers covering the whole range of the examination. The pupil, on each of his three weekly visits, found one of these papers awaiting him in the outside room, and proceeded to answer it as well as he could on the backs of old examination scripts. If he had not brought a pen of his own, he had to search among a lot of ancient quills until he could find one that was not hopelessly spoiled. Presently, Mr. X would be politely summoned to an inner parlour, where his last exercise would be returned to him corrected and annotated, and if he had failed to answer any question he would be either shown a solution or given a hint how to proceed.

Of course, it was not every pupil that was taken separately like this; some of them were taken in small batches (not exceeding five or six), but the general method was the same. It should be added that once every week each pupil took away with him a printed problem paper to be done at leisure in his own rooms. The results were marked, and the list was available for inspection.

As a member of St. John's College staff Besant used to give "lectures" of a sort; but (unlike Routh) he eschewed formal lectures on bookwork. His solutions of problems were always original and elegant, and he had the great advantage (for a coach) of being equally good in geometry, analysis, and dynamics.

Besides being one of the *par nobile fratrum* of coaches, Besant was a busy and trusted examiner, and in this connection it may be recorded that he used to say that ten minutes of oral examination were worth any amount of written *ditto*.

Besant was too much engrossed by his proper work to add much to mathematical literature. His text-books on conics, dynamics, hydrostatics, and hydrodynamics deserved their popularity, and are still worth consulting, though their point of view is now rather antiquated. His one thoroughly original printed work, the tract on roulettes and glissettes (first edition, 1869; second edition, enlarged, 1890), shows all his qualifications at their best. Besant had really studied Newton, and had an exceptional power of estimating different orders of infinitesimals from a figure. His invention of the term

"glissette" is a reminder to those who knew him that he preferred the works of the great French mathematicians to all others, and would rather read a good text-book in French than one in English.

It used to be a commonplace among Cambridge undergraduates that Besant was the handsomest Senior Wrangler that ever was. Anyhow, he was a very handsome man; so far as his head and face were concerned, he resembled the photographs of Russell Lowell. The left eye and eyebrow were damaged by a mountaineering accident. Above all, his manners were perfect—or as near perfection as human manners can be (curiously enough, his gyp Scott, when I knew them both, was the most gentlemanly gyp in college); no one who had much to do with Besant could help trying to be polite.

Besant was Senior in 1850 (four years before Routh), F.R.S. in 1871, and Sc.D. (Cant.) when that degree was first instituted. He and Routh were the first two to receive it, and he really enjoyed the distinction, though he used to pretend that he accepted it only to please his "womenfolk,"[1] and had to take a cab to the Senate House, lest ribald boys should jeer at his salmon and geranium gown.

G. B. M.

NOTES.

WE notice with much regret the announcement of the death on June 9 of Prof. T. McKenny Hughes, F.R.S., Woodwardian professor of geology in the University of Cambridge, at eighty-five years of age.

IN the list of birthday honours last week we ought to have included the names of Lieut.-Col. A. W. Crossley, F.R.S., and Lieut.-Col. E. F. Harrison, two chemists who have received the distinction of C.M.G. in recognition of valuable services in connection with the war.

SIR WILLIAM D. NIVEN, whose death was announced in last week's NATURE, was born at Peterhead in 1842. After attending the Grammar School there, he entered King's College, Aberdeen, and graduated in 1861, obtaining the Simpson prize in mathematics. He afterwards entered the University of Cambridge, where he graduated in 1866 Elected to a fellowship in Trinity College, he for some years acted as assistant tutor. For a time he held an appointment at the Royal Military Academy, Woolwich, but he was back again in Cambridge by 1873. In 1883 he succeeded Dr. Hirst as Director of Studies at the Royal Naval College, Greenwich, a post which he held until his retirement in 1903, when he was created K.C.B., having been made C.B in 1897. He was elected a fellow of the Royal Society in 1882, and served for several years on the council of the society, and for a period of two years was vice-president. He was president of the London Mathematical Society in 1908 and 1909. Sir William was the author of numerous papers in mathematics and mathematical physics. He was virtually Clerk Maxwell's literary executor, and prepared and edited his collected works. His services as Director of Naval Education won the high regard of the Service and the attachment of the chiefs of its scientific branches. In recognition of his work, a group of scientific friends presented him with his portrait in 1911, and it is preserved in the collection of the University of Aberdeen.

THE death is announced, on June 11, at eighty-six years of age, of Sir W. C. Macdonald, the Chancellor and President of McGill University, and a generous benefactor to education and science in Canada. A list of his chief donations given in the *Times* of June 12 is here summarised. The gifts to McGill University included a fully equipped engineering building, which cost more than 70,000*l*., besides endowment; a physics building, costing 60,000*l*.; a building for the departments of chemistry, mining, and architecture, costing 100,000*l*.; 30,000*l*. to endow the faculty of law; 18,000*l*. for two chairs of physics; at least 42,000*l*. for the endowment of engineering; 10,000*l*. for a pension fund, and other endowments; also a large area of land close to McGill, and bought for 200,000*l*. for the University. To promote rural education, Sir William Macdonald established four "consolidated schools," one each in Ontario, New Brunswick, Nova Scotia, and Prince Edward Island, all equipped for manual training, household science, and nature-study in practical gardening, as well as for the more conventional subjects, spending about 36,000*l*. on this experiment; and the sequel was the establishment of the Macdonald College at St. Ann's for teachers, farmers, and farmers' wives at a cost of about 600,000*l*. When the college was complete the founder presented it to McGill, along with 400,000*l*. as endowment.

THE interim and final reports of the Halakite inquiry have been issued by H.M. Stationery Office (Cd. 8446, price 1*d*.). The general findings of Mr. Justice Shearman, with whom Prof. W. J. Pope sat as assessor, have been widely read but particular interest attaches to Prof. Pope's report. The original specification refers to an explosive having as a basis an admixture of lead nitrate with glycerine, and prescribes hydrocarbons, nitro-compounds, such as collodion or nitrobenzene, and barium and potassium chlorates and nitrates as possible constituents. It is stated that under the working conditions employed the glycerine reacts with the metallic nitrates to form a nitro-compound. Such a claim "is untrue, and the specification is the production of charlatans who seek to conceal the worthless nature of their invention by the use of a scientific terminology." The earlier samples submitted did consist largely of metallic nitrates, the proportions of which varied considerably, but the nitro-compounds were found to be short lengths of Mark I. cordite. Indeed, all samples presented to the court contained manufactured cordite as the common ingredient. Halakite was recommended by its proprietors for use as a smokeless powder for propellent purposes and as a bursting charge for shells. The report points out that explosives of such composition are so sensitive to shock that they cannot be used as high explosive for shell with any reasonable degree of safety, whilst the considerable proportion of metallic nitrates renders them unsuitable for propellent purposes because of low explosive power and dense smoke. A later sample submitted to the French Government in April, 1916, proved to consist of about 98 per cent. of Mark I. cordite, the balance being mainly lead chromate Prof. Pope says that the clumsy nature of the fraud was obvious to the British and French authorities concerned The whole case is an illustration of the stupidity of otherwise astute business men accepting statements of self-styled "inventors," and failing to avail themselves of the advice of an independent expert chemist, which action certainly would have saved large sums of money and the waste of much valuable public time, as well as avoided a depressing public inquiry.

[1] Perhaps, like the Antiquary, he said "womankind"; I forget.

A JOINT meeting of the Society of Glass Technology with the Faraday Society will be held at the Applied Science Department, the University, Sheffield, on Wednesday, June 20, at 3.30 p.m., when a discussion will take place on "The Choice of Refractory Materials for Use in the Glass Industry." The discussion will be opened by Prof. W. G. Fearnsides, with a paper on "Supplies of Refractory Materials for Use in the Glass Industry."

THE council of the Royal Society of Edinburgh has made the following awards of prizes:—(1) The Makdougall-Brisbane prize to Dr. R. A. Houstoun, for his series of papers on "The Absorption of Light by Inorganic Salts," published in the Proceedings of the society; (2) the Gunning Victoria prize to Sir Thomas Muir, for his series of memoirs upon "The Theory and History of Determinants and Allied Forms," published in the Transactions and Proceedings of the society between the years 1872 and 1915.

THE second annual meeting of the Geological Physics Society was held at the rooms of the Geological Society on May 25, with the president, Prof. Benjamin Moore, in the chair. The following were elected members of the council:—Prof. B. Moore (president), Dr. G. Abbott, Dr. V. Elsden, Dr. Dawson Williams, Messrs. G. W. Bulman, C. H. Grinling, W. F. Gwinnell, E. Haviland, W. H. Richardson, E. K. Robinson, and A. C. Young. Mr. H. Davey was appointed hon. secretary *pro tem.* A discussion on "The Origin of Flints" was opened by the president.

THE battle of Messines opened on June 7 at 3.10 a.m. with the simultaneous explosion of nineteen large mines along a front ten miles in length. The total amount of explosives fired is estimated at about 450 tons, and one of the largest craters was afterwards found to be about one hundred yards in diameter and seventy feet in depth. Several people in and near London, including the Prime Minister, are said to have heard the sound, and a small movement recorded by a seismograph at Shide may have been a result of the explosion. The distance of London from Messines is about 145 miles, and that of Shide about 185 miles.

DR. F. O'B. ELLISON sends us a description of a curious meteorological phenomenon observed by him on June 1 at about 5.45 p.m. G.M.T., on leaving St. Mary's Hospital Medical School. He writes:—"The western sky was covered with a sheet of cirrus of a somewhat patchy appearance. The sun was shining through it strongly, about 20° above the horizon. There was no halo round the sun. About 20° from the zenith, and with its centre apparently at the zenith, was what appeared exactly like a very bright rainbow, in length a quarter of a circle, with the red on its convex border towards the sun. It was brightest when I first saw it, and gradually faded, having disappeared in about fifteen minutes. The bow was of uniform brilliance, with no 'mock sun' upon it, and was of sufficiently striking aspect to attract the attention of some railwaymen working near."

A TELEGRAM from the President of the Republic of Salvador to the Legation in London announces that an earthquake produced by the San Salvador volcano has destroyed a great part of various places in the Department of La Libertad and some in the Department of San Salvador. The capital has suffered considerably. It is estimated that there were forty killed and 100 injured in Armenia and Quezaltepeque, but none at San Salvador. The telegram does not give the date of the disaster, but it was known on June 7 that the volcano of San Salvador was in eruption. The city of San Salvador was founded in 1528, close to the great volcano of the same name. In less than four centuries it has been ruined eleven times by earthquakes, four times in the last century, namely, in 1806, 1815, 1854, and 1873. This recurrence of disastrous earthquakes in the same limited region seems to point to their volcanic origin, for great tectonic earthquakes are subject to constant focal migrations.

THE death is announced, in his seventy-seventh year, of Dr. Arnold Hague, who had been one of the geologists of the U.S. Survey since 1879. He had previously been connected with Clarence King's exploration of the 40th parallel, and with the official survey of the Cordilleras of North America from the Great Plains to the Sierra Nevada. In 1877–78 he was Government geologist of Guatemala, and travelled extensively over that country, especially in the mining and volcanic districts. In 1878 he was engaged by the Chinese Government to examine the gold, silver, and lead mines in northern China. He was best known by his work in the Yellowstone District, and most notably by his investigations of the geysers in connection with the extinct volcanoes. He was a member of the commission appointed by the National Academy of Sciences at the request of the U.S. Government in 1896 to prepare a plan of the national forest reserves. He received honorary doctorates from Aberdeen and Columbia Universities, was a vice-president of several international geological congresses, and in 1910 was president of the Geological Society of America.

LIEUT. ALAN GORDON HARPER, whose death is announced at twenty-eight years of age, was educated at Dulwich and at Magdalen College, Oxford, of which he was a demy. In 1912 he took the honours school in botany, and afterwards the diploma in rural economy. For work on the effects on the timber of defoliation by the caterpillar of the large larch sawfly, *Namatus Erichsoni*, he secured the degree of B.Sc. A preliminary report on this research was made to the British Association at Dundee in 1912, the full work being published in the *Annals of Botany* in 1913. After acting for a year as assistant in the Botanical Department of the University College of North Wales, Lieut. Harper returned to Oxford as demonstrator in the School of Rural Economy, where he carried out a research on the structure of timber as influenced by pressure stimuli (*Quarterly Journal of Forestry*, July, 1914). He also worked on the protomorphic shoots of Pinus, publishing a paper in the same journal in April, 1914. The acceptance of the post of deputy professor of botany in the Presidency College of Madras gave him the attractive opportunity of first-hand acquaintance with Indian vegetation. At the outbreak of war he secured a commission in the R.F.A., and on June 1 of this year he met an instantaneous death on the Western front.

THAT Italy realises the necessity of founding scientific laboratories is evident from a paragraph in a recent number of *L'Economista d'Italia*. So far as can be gathered, the scheme would appear to have been inaugurated by the "National Scientific and Technical Committee," which was formed last year in Milan. At a recent meeting of the industrial section of this committee (on which the leading Italian manufacturers are represented) it was stated that the desire of the committee was to "raise scientific laboratories to the level of similar institutions abroad." Signor Ruffini has already promised one million lire (40,000*l.*), together with an annual donation, and the warm support of the Government and of leading manu-

facturers is assured. The selection and training of the staffs are to be left to the committee already mentioned. The laboratories will apparently be established at the technical colleges, and will be devoted especially to physical and chemical research. The need for such laboratories is pressing, the committee being firmly convinced that "their efficiency will also depend on the rapidity with which the plan is put into execution, as Italy has every need to have available as soon after the war as possible all the scientific, technical, and industrial resources she can muster with the view of increasing production in the most favourable economic conditions and of improving the quality of her products." The scheme for the creation of the laboratories has formed the subject of a special memorandum, which is not reproduced in the journal mentioned above.

IN Memoir No. 91 of the Canadian Department of Mines Mr. E. W. Hawkes publishes an exhaustive monograph on the Labrador Eskimo. The author had already lived three years among the tribe in Alaska, and his previous knowledge of the race was useful, because the ethnological divisions of the Eskimo are geographical rather than cultural. The most interesting point in the inquiry is the proof that these were the people known as the Skraelings mentioned in the Saga of Eric the Red, who describes how the Vikings "saw a great number of skin canoes, and staves were brandished from their boats with a noise like flails, and they were revolved in the same direction in which the sun moves." This is obviously an attempt of the Norse singer to describe the Eskimo kayaks or skin boats. The noise of the double-bladed paddles might well be likened to that of flails. Elsewhere the bard speaks of the Skraeling boats approaching from the south, when "all their staves waved in a direction contrary to that of the sun." This is explained by the fact that in the former case the boats were coming from the north, in the second from the south, when the apparent motion of the paddles would necessarily be reversed. The monograph is a valuable addition to the accounts of the Eskimo by E. W. Nelson in the eighteenth annual report of the Bureau of American Ethnology, and by F. Boas in the sixth annual report in the same series.

THE April number of the Journal of the Royal Microscopical Society (No. 237) contains an article by Drs. Drew and Griffin on the parasitology of pyorrhœa alveolaris. At least six species of spirochætes, together with numbers of bacteria, were detected. Two species of amœbæ also seem invariably to be present, and their life-cycles were worked out. The authors suggest that mechanical injury seems to play an important part in initiating the condition; once the injury has occurred, the spirochætes probably play the chief part in the disease, causing tissue destruction and the formation of pockets, which then become infected by bacteria. The paper is illustrated with four plates. Two interesting letters written in 1877 by Prof. Abbe to the English microscopist, John Ware Stephenson, relating to the design and production of the first homogeneous immersion microscope objectives, are communicated by Mr. Cheshire to this number.

IN the *Psychological Review* (vol. xxiv., No. 3) Mr. Daniel Starch gives the results of his experiments on the similarity of brothers and sisters in mental traits. He wished to find out to what extent children of the same parents are alike in mental characteristics, and to determine whether the similarity, if any, was greater in those mental traits which are directly affected by training in school work than it is in those traits which are not so directly affected. He therefore chose tests of both types, *e.g.* speed and comprehension of reading ability, size of vocabulary, speed and quality of hand-writing, and ability in spelling for one group, and tests of perception, memory, and motor capacity for the other. He found that the resemblance of such children is approximately as great in mental traits as in physical, as found by Prof. Karl Pearson, and that the resemblance was greater in those tests which were less affected by school work. The article seems to corroborate the view that the mental make-up of human beings is as much a matter of heredity as their physical make-up, and that environment plays a relatively small part in producing the resemblance of closely related individuals.

AN important memoir on the baboons of Celebes, by Dr. J. Buttikofer, forms part i. of vol. iii. of *Zoologische Mededeelingen*. Of these animals the author recognises eight species, which he relegates to the genus Cynopithecus, dividing them into two groups, mainly on cranial characters. Specific characters are based on the general coloration and the shape and coloration of the gluteal callosities. The very complete survey of the literature of this theme, and the numerous coloured plates and text-figures, make this a most welcome contribution.

MR. ERIC B. DUNLOP, in *British Birds* for May, records some remarkable instances of polygamy among rooks. In one case he describes two females sharing one nest, incubating side by side in perfect harmony. Both sitting birds were fed in turn by one male, who was welcomed on his approach with food by much wing-shaking, after the fashion of young birds. Later, when the young appeared, this dutiful husband fed both his wives and the youngsters. The writer records two other cases of a like kind. But in these each female had a separate nest. In the same issue Mr. H. F. Witherby gives a further instalment of his valuable notes on moulting. He deals now with the flycatchers and the warblers, giving a very complete history, probably the most complete yet written, of this very interesting and important phase in their life-history, which has hitherto been strangely neglected. As might be supposed, a number of new facts are now placed on record.

PROF. C. CHILTON has examined some terrestrial Isopoda from the shore of the Chilka Lake, and his report upon them appears in the Memoirs of the Indian Museum (vol. v.). The name Isopoda, implying resemblance throughout the sevenfold series of legs, suited many, though far from all, of the groups to which Latreille applied it a century ago. It fits the terrestrial and semi-terrestrial, or "maritime," genera. Belonging to the latter set is a species described in 1828, the *Ligia exotica*, Roux, which, in its vast distribution, has not neglected Lake Chilka. "On Barkula I. it is enormously abundant. Though individuals may be found running on the shore at all times of the day and night, even on rocks heated by the midday sun, the species is most active in the morning and evening. It may then be seen in great droves, numbering sometimes hundreds of individuals, all of which move in the same direction." Though usually avoiding water, whether fresh or brackish, a drove meeting a pool will not hesitate to swim across it. Of this species Prof. Chilton says:—"Though it is so common and has been known for many years, it has received only scanty attention at the hands of those who have recorded it, most observers having merely mentioned its occurrence without adding to previous descriptions." No such reproach will be likely to assail the detailed account and illustrations which

Prof. Chilton now supplies. Only one small oversight may be noted. While the text duly explains that in the young the seventh peræon-segment bears no appendages, such appendages are nevertheless displayed in the adjoining figure.

BULLETIN No. 4 of the Department of Chemistry, South Australia, contains an interesting account of the marine fibre industry of Spencer's and St. Vincent's Gulfs, near Adelaide. The fibre is derived from *Posidonia australis*, a marine plant of the family Naiadaceæ, to which our familiar pond-weeds (Potamogeton) belong. The fibre consists of the remains of the plant which have been accumulating for centuries, and have become naturally retted through the decay of the soft parts. It is estimated that the workable deposits cover some 240 square miles, and at a yield of 6 lb. of fibre per cubic yard, and an average depth of deposit of 7 ft., this means a yield of 19,200 tons of air-dried fibre per square mile. Attention was first directed to the possibilities of an industry in the fibre in 1902, and now three large companies are at work. The fibre is useful for insulating purposes, the manufacture of bedding, etc. The paper gives an illustrated account of the methods employed for raising the material from the sea, and general details as to the methods of cleaning and preparing the fibre for the market.

ATTENTION is very properly directed in the *Agricultural News* of March 10 to the remarkable progress made in recent years in the agricultural departments of the Windward and Leeward Islands, which progress, it should be pointed out, is largely due to the fostering care and advice of the Imperial Department of Agriculture under the Commissioner, Sir Francis Watts. Starting from small botanic stations, each island has now a well-organised agricultural department, and the various islands are devoting their energies to the economic products most suitable for their particular conditions. The cotton industry in St. Vincent, Montserrat, St. Kitts, and Nevis; the onion-growing activity in Antigua, Montserrat, and the Virgin Islands; limes in Dominica, Grenada, and St. Lucia, are all thriving industries. Mention should also be made of the land settlement and peasant instruction work of the departments in St. Vincent and St. Lucia, which has been attended with great success. Further, in Dominica, in addition to its beautiful botanic garden, there is an excellent system of agricultural education in operation, and the science of horticulture is maintained at a very high level in the island.

WE learn from *La Géographie* (vol. xxxi., No. 4) that a small Swedish expedition has left for Juan Fernandez and the Galapagos Islands. The expedition, which is for botanical and zoological work, is under the leadership of Dr. Carl Skottsberg, who was a member of the Swedish Antarctic Expedition of 1901–3. Dr. Skottsberg in 1907–8 led an expedition to Patagonia, the Falkland Islands, South Georgia, and Juan Fernandez. The last scientific expedition to the Galapagos Islands was that of the California Academy of Sciences in 1905–6, when Mr. Alban Stewart made a thorough botanical exploration of the group and a great deal of zoological work was done.

THE want of coal which is seriously affecting Norway has already made her turn to the valuable Spitsbergen deposits. According to *La Géographie* (vol. xxxi., No. 4) Bear Island, another unclaimed Arctic land, is now attracting her attention. During last summer a party of Norwegian miners was at work on a coal-seam there which has been known for many years, and several wintered on the island in the hope of having a cargo ready for shipment to Norway this summer. Previous reports on the coal of Bear Island have not indicated very extensive deposits, but the great drawback to mining is the absence of safe anchorage. The Norwegian syndicate appears to consider the construction of a port. A meteorological observatory and wireless station are also proposed. A further discovery of coal in Spitsbergen is reported by a Russian expedition. According to the *Bolletino* of the Royal Italian Geographical Society (vol. vi., Nos. 4–5), the highest seam is near the surface and extends over an area of 450 square kilometres. It is estimated that this coalfield could produce 200,000 tons a year.

IN our issue of May 17 we quoted, without comment, from the *National Geographic Magazine*, published by the National Geographic Society of Washington, a forecast that, assuming that there is no immigration, and that the United States will grow as fast during the three centuries ahead of us as Europe grew from 1812 to 1912, the population will amount to nearly 500,000,000 in 2217, or approximately 166 to the square mile. A correspondent writing under the name of "A London Statistician" questions the accuracy of this estimate, mainly on the ground that in certain States the former rate of increase has not been maintained among the American-born population. This fact has been admitted and explained by General Walker (see "Encyclopædia Britannica," eleventh edition, xxvii., 635) on the grounds of a rise in the standard of living, the multiplication of artificial necessities, the extension of a paid domestic service, and the introduction of women into factory labour. Our correspondent shows good reasons for confirming these views, and, in any case, a forecast of this kind is liable to modification by recent events—the probable loss of life in war, a change in the conditions of production and domestic life, and the amount of emigration from European countries—resulting from the world-wide conflict which is now in progress.

THE papers, verbal discussion, and written communications contributed to the symposium on refractory materials held at the Faraday Society on November 8, 1916, have now been reprinted from the Transactions in a brochure of 189 pages. A brief account of the meeting was published in these columns on December 7, 1916. The principal additions to the symposium are the following:—(1) A note on the composition of clay and on silica bricks, by Prof. H. Le Chatelier, containing some striking photomicrographs of quartzite and cristobalite; (2) two short papers by Prof. H. B. Cronshaw, one on "The Deterioration of Refractory Materials in the Iron and Steel Industries," the other on "The Standardisation of Refractory Materials used in the Iron and Steel Industries"; and (3) a paper by Mr. R. B. Sosman, of the Geophysical Laboratory, Washington, on the common refractory oxides. The Faraday Society is to be especially congratulated on having obtained Mr. Sosman's contribution, which gives considerable information about the results of experimental inquiry obtained in the Geophysical Laboratory. It deals with the common rock-forming oxides—silica, alumina, lime, magnesia, and the oxides of iron. The last-named offer a research problem quite different in character from that of the other oxides by reason of the fact that their compositions and properties at high temperatures depend upon the pressure of the oxygen in contact with them. Ferric oxide, Fe_2O_3, begins to dissociate as the temperature rises into oxygen and a solid solution containing ferrous iron. At a given temperature the initial dissociation pressure is high, but it drops rapidly as the percentage of FeO in the solid increases,

passing through a range in which the pressure falls rather slowly with change of composition, and finally falling rapidly to the dissociation pressure of Fe_3O_4, which is very low. This in turn dissociates into oxygen and a mixture of oxides the character of which has not yet been determined. The properties of FeO are still practically unknown.

IN the March–April number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* Prof. Ch. Féry gives some particulars of the work of the optical laboratory of the Ecole de Physique et de Chimie Industrielles at Paris. The present laboratory has been available for students for four years. Before and since its erection many important researches have been carried out, and, more particularly, the experiments undertaken so successfully of recent years by Prof. Féry on optical pyrometry. Prof. Féry is probably the most competent authority on this subject, and his methods may be said to be of almost universal application in works practice. Among other recent investigations may be mentioned the following:—Research on the calorific emission of the sun; note on the solar constant and apparent temperature of the sun; researches on radiation; an absorption spectrophotometer; an electric chronometer; a new thermo-electric calorimeter; the principle of a new method of measuring the velocity of light; and the chemical theory of lead-plate accumulators. The laboratory was the birthplace of the Grassot fluxmeter and the now world-famed Méker burner. This list shows that the laboratory has been keenly alive to industrial and scientific research, as well as to instruction. Special dark-rooms are provided in the laboratory for photometric and other optical experiments, while a balcony allows of experiments being conducted in the open air. Further rooms are provided for work on the optical bench, for the metallography of steel and alloys, and for chemical experiments. Special rooms are provided in the basement, built on masonry foundations, for work where absence of vibration is required. All rooms are carefully heated, lighted, and ventilated. The new electrochemical and physical laboratories and that devoted to the investigation of dyes, the mineralogical collections, the central library, and the lecture-rooms, are all built on modern principles, and directed, like the optics laboratory, with due regard to modern teaching and research requirements.

MESSRS. A. AND C. BLACK, LTD., announce for immediate publication "An Introduction to the Physiology and Psychology of Sex," by Dr. S. Herbert. The work will direct attention to the important facts respecting sex, mating, and reproduction, from the physiological and psychological points of view.

OUR ASTRONOMICAL COLUMN.

COMET 1917*b* (SCHAUMASSE).—The following continuation of the ephemeris for Greenwich midnight given in NATURE of May 31 has been received from Copenhagen:—

1917	R.A. h. m. s.	Decl. ° ′	Log *r*	Log Δ	Mag.
June 15	9 25 28	+18 24·8			
17	28 2	17 12·3	9·9829	0·0550	10·6
21	32 8	15 12·5	0·0033	0·1071	10·9
25	35 20	13 36·7	0·0238	0·1528	11·3
29	37 59	12 17·5	0·0442	0·1925	11·6
July 3	40 17	11 10·3	0·0642	0·2276	11·8
7	42 21	10 11·9	0·0837	0·2587	12·1

THE SPECTRUM OF COMET 1917*a* (MELLISH).—Prof. Frost reports that the spectrum of Mellish's comet, as observed at the Yerkes Observatory on March 21, showed a close resemblance to that of Morehouse's comet (Journ. R.A.S. Canada, vol. xi., p. 196). The cyanogen band 3883 and the blue carbon band, with its red edge at 4741, were strong, and there were other bands at 3914, 4017, and 5075. It may be remarked that the band 3914 was probably the negative band of nitrogen at that wave-length, while 4017 and 5075 would appear to be two of the bands of the low-pressure spectrum of carbon monoxide, these being especially characteristic of the tails of comets.

EFFECTIVE TEMPERATURES OF STARS.—The values of stellar temperatures derived by Rosenberg from comparisons of the intensity at different wave-lengths in photographic spectra have been discussed by Dr. Wilsing (*Astronomische Nachrichten*, No. 4881). A new reduction of Rosenberg's observations has brought the results for stars of early type into much closer accordance with the Potsdam values, as will appear from the examples included in the following table:—

	Type	Rosenberg	Rosenberg corrected	Scheiner and Wilsing
α Andromedæ ...	I.*a* 2	33,000	13,500	8,800
α Pegasi	I.*a* 2	27,500	12,200	13,600
γ Geminorum ...	I.*a* 2	16,000	10,000	11,800
α Aquilæ	I.*a* 3	10,500	7,700	7,700
η Bootis	II.*a*	5,500	4,700	5,200
γ Cygni	II.*a*	5,100	4,400	6,000
ε Bootis	II.*a*–III.*a*	5,300	4,500	4,200
α Bootis	II.*a*–III.*a*	3,100	2,800	3,600
β Andromedæ ...	II.*a*–III.*a*	2,650	2,400	3,000
α Orionis	III.*a*	2,200	2,000	3,000

Scheiner and Wilsing's values were based upon visual observations with a spectrophotometer.

THE FELLOWSHIP OF THE ROYAL SOCIETY.

IN the annual report of the council of the Royal Society, adopted at a special general meeting in November last, certain changes in one of the statutes relating to the election of fellows were submitted. These changes were put forward after detailed deliberation by the council, and were based upon a report prepared by a committee appointed to consider the subject. Statute XII. of the society provides for the special election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the society, provided that not more than two persons shall be so recommended in any one calendar year, and if two persons be elected in any one year there shall be no election in the following year."

By the new statute proposed by the council and adopted at the special meeting on November 2, 1916, the council could recommend to the society for election "(A) Privy Councillors whose election would assist the society; (B) men distinguished in the scientific or educational service of the State, or by their services to science and its applications, provided that (1) the number of fellows in Class A shall not exceed twenty-five at any time, including the fellows elected as Privy Councillors under the statutes in force before 1903; (2) the number of fellows in Class B shall not exceed twenty-five at any time, not more than five being elected in any one year." As in the original statute, any person so recommended for election had to receive the votes of two-thirds of the members of council present, and the number of votes in his favour had to be not fewer than eleven.

In February last a memorial signed by a large number of fellows of the society was presented to the council asking that steps should be taken to consult

the general body of fellows as to the introduction of the amended statute, and not to proceed with any recommendation for election under it before thorough reconsideration of the whole question. Fear was expressed that the amended statute might result in the election under (A) of "a politician, not at all necessarily of high distinction, who may be engaged in particular legislative or other public activity, on the ground only that his election would assist the work of the society," and under (B) of generous donors to the society or other scientific institutions, and the chief permanent officials of all departments of State concerned with scientific matters.

At the request of the memorialists, a special general meeting was held on June 7 to reconsider the amended statute, and the following resolution, moved by Sir David Bruce and seconded by Sir E. Ray Lankester, was carried after a long discussion:—"That this meeting is of opinion that the council will serve the best interests of the society by restoring Statute XII. to the form it had before the change made in it by the council on November 2, 1916, and by postponing further consideration of the statute relating to the election of fellows until after the termination of the war."

The action of the council in endeavouring to provide for the election of a few fellows on a broader basis than at present exists is thus practically undone. It was thought by some fellows that opposition to the new statute might have been met by a resolution to suspend elections under it during the war, and to leave any question of rescinding it until after the war; but the meeting decided to refer back to the council the whole question of amendment. A new council is, however, now in office, and the considerations which led to the recommendation of the amended statute will have to be gone over again in detail for the benefit of the new members when the resolution comes before the council.

THE ANIMAL SYMBOL OF THE EGYPTIAN DEITY, SET.

M. G. DARESSY has been writing[1] concerning the long-disputed question as to the identity of one of the animals which the old Egyptians selected as the symbol of their malevolent deity, Set, or Seth. Among creatures suggested as intended by the Egyptian artists have been the jackal, hare, oryx, and okapi, but all these assignments have been abandoned.

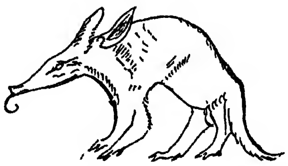
Two years ago Dr. Schweinfurth decided upon the orycterope, or anteater, the Erdferkel of the Sudan and Aardvaark of the Boers, because of the almost absolute resemblance of its head and snout to the Set quadrupeds.

The long legs and tail shown in Egyptian drawings, the tail often depicted vertically erect, and with double tufted end, render this attribution difficult, so M. Daressy has reviewed the question from the archæological side, summarising important Egyptian writings, and citing the delineations of the Set animal by their draughtsmen. From the literary side he illustrates the question from myth and stories of Set, of whom the creature was the crest, totem, and symbolic hieroglyph.

In the myths, when Set, with his name changed to Souti, became ally, instead of foe, of Horus, he was deemed lord of Upper Egypt, as Horus was of Lower Egypt and the Delta. This suggests that Set may have been a ruler of Upper Egypt, who warred with Osiris, King of Lower Egypt, and later also with Horus.

Although the myths speak of Set as god of evil, darkness, and the sterile deserts, the fact of his in some cases being said to have been reconciled to Horus, though he had assassinated Horus's father, Osiris, caused Set to be semi-deified, and a few shrines for his worship have been found as Souti. At Edfu he was a crocodile, though never worshipped under that type, crocodile deities such as Sobk and Pnepheros being different concepts. Set took other evil animal forms, such as the boar and swine, creatures abhorred in many religions. M. Daressy argues that the Set animal is really a creation of the imagination, the object of the design being to depict a creature so constructed as to be impotent to destroy Horus. If this was so, it is futile to search for the creature in either the existing or fossil fauna of Africa.


Egyptian drawing of head of Set animal.


Orycterope aethiopicus.


Set Pharaonic crest.

M. Daressy thinks the design embodies all the most opposite characters to those of a boar. If so, the animal is merely a fantastic design to symbolise the evil aspect of the deity.

But once in Egyptian history a Pharaoh, instead of using the falcon, which was their solar Horus dynastic crest, for his totem, in the Second or Third Dynasty employed for his honour the Set animal. This king was probably ruler of Upper Egypt solely, but his successor, to assure his subjects that he was under the tutelary protection of all Egypt's deities, used the double crests of the Set animal and Horus falcon, and the Set one was never used again for a royal symbol. It is very improbable this would have been done if the Set figure was a sort of serio-comic invention.


Head of Set in Spink collection.

It should be borne in mind that the ancient Egyptian animal-gods were (unless Set is an exception) real existing creatures. The Sphinx was not a god, or even totem of any particular deity. In the tombs at Beni Hassan various fantastic animals are depicted as denizens of the desert, and real ones also. The Set creature is there placed between a real and an imaginary one. An interesting fact is that the greater the antiquity of the figure, the less abnormal are its features from those of a dog, or jackal, or some allied species. Thus on some of the Serekh figures containing the name of the early dynasty Pharaoh, Perabsen, the Set quadruped is identical with old Egyptian drawings of jackals, which were sacred to Anubis excepting for its long erect tail, which has not the forked ending introduced later.

This Pharaoh only bore the Upper Egypt crown, so the creature, if a real one, may not have existed in Lower Egypt, and Set himself, as noted, seems to have ruled in Upper Egypt only.

It is just possible that remains of a member of the

[1] M. Daressy's article may be found in the Bulletin de l'Institut Français d'Archéologie Orientale, tome xiii., pp. 77–92.

Canidæ family now extinct may be found that will explain the anomaly.

Unfortunately, the prehensile lips and snout, so well indicated by the unique and very ancient bronze head which Messrs. Spink, of St. James's, have kindly permitted us to publish, would not be indicated by any of the bones.

It may be that the animal was very scarce, and that after its association with the detested deity it was exterminated by the Horus - following, orthodox Egyptians. JOSEPH OFFORD.

TECHNICAL OPTICS.

THE establishment of a Department of Technical Optics at the Imperial College of Science and Technology, and the appointment of Mr. F. J. Cheshire as the director of the department, were announced in NATURE of May 24 (p. 257). The report of the Board of Education for the year 1915–16 just issued (Cd. 8594, price 6d.) includes the following reference to this subject:—

After many years of discussion the establishment of a Department of Technical Optics is at last assured, and the Board desires in this connection to express its appreciation of the action of the London County Council, to whom the realisation of the scheme is largely due. The scheme involves the co-operation of the Imperial College of Science and Technology at South Kensington and the Northampton Polytechnic Institute in Clerkenwell. The more elementary instruction will be given at the Northampton Polytechnic Institute; the advanced full-time courses, and most of the research work, will be centred at the Imperial College. The work in technical optics at both institutions will be under the control of a director, who will be a professor of the Imperial College, and will be given the position of honorary head of a department in the Northampton Institute.

The governors of the Imperial College have appointed a Technical Optics Committee to manage under them the work for which they are responsible; and the London County Council has appointed the same committee to advise it as to the work to be done at the Northampton Institute. The Right Hon. A. H. D. Acland, who is chairman of the Executive Committee of the Imperial College and a member of the Committee of His Majesty's Privy Council on Scientific and Industrial Research, has consented to act as chairman of the Technical Optics Committee. This committee will contain representatives of the Admiralty, the War Office, and the Ministry of Munitions, and also of employers and workers in the trade.

At the outset the annual cost of maintaining the new scheme is estimated to be not less than 5000*l*., while 5500*l*. is needed for alterations and equipment. Of these sums the London County Council is prepared to find 2000*l*. a year (including 1000*l*. for the work at the Imperial College, and an increase of not more than 1000*l*. in its maintenance grant to the Northampton Institute), together with 750*l*. towards the necessary equipment at South Kensington and 2500*l*. for alterations and new equipment at Clerkenwell. The Board of Education will make an additional annual grant of 2000*l*. to the Imperial College as from April 1, 1917, and a capital grant of 1500*l*. for equipment, while the extended provision for technical optics at the Northampton Institute will be taken into account in fixing the amount of the Board's block grant to that institution under the Regulations for Technical Schools. The Department of Scientific and Industrial Research is prepared to make a grant of 1000*l*. a year for five years to the Imperial College and an equipment grant of 750*l*. in respect of the research work which will be undertaken by the new Institute of Technical Optics.

Mr. Frederic J. Cheshire has been appointed head of the new department at the Imperial College for a period of five years, with the title Director of Technical Optics and Professor of Technical Optics at the Imperial College. Mr. Cheshire's long experience and great ability in optical matters practically ensure a successful beginning. He has been associated with optical instruments for many years at the Patent Office, and since the formation of the Ministry of Munitions has been Deputy Director-General of the Ministry and Technical Director of the Optical Department of the Ministry. He is the present president of the Optical Society. It is expected that, subject to the conclusion of certain arrangements with the Treasury, Mr. Cheshire will accept the directorship, and it is anticipated that the organisation of the department will be rapidly completed, and that training will begin at an early date.

THE CONFIGURATIONS OF ASTRONOMICAL MASSES AND THE FIGURE OF THE EARTH.[1]

A STUDY of the forms which can be assumed by masses of actual compressible matter under their own gravitation is of obvious importance for cosmogony and astronomy. A theorem of fundamental importance is that for a given mass, acted on by given forces and rotating at a given speed, there is only one equilibrium arrangement of the internal strata when the boundary is fixed. Thus possible figures of equilibrium can be classified by their boundaries; the interior matter will arrange itself.

A simple application is to the figure of the earth. Regarding the earth's surface as roughly spherical, the internal layers of equal density must be concentric spheres. The view that the internal strata may be, or in some past age may have been, excentric, is found to be illusory, and an attempted explanation of the major inequalities of the earth's surface in terms of this idea fails.

A more complex application is to the figures of compressible masses, such as gases, in rotation. It is found that a shrinking compressible mass will, in general, assume in turn figures which may be described as pseudo-spheroids and pseudo-ellipsoids, these being derived by continuous distortion from the spheroids and ellipsoids which form the only stable figures of equilibrium for incompressible masses. The pseudo-spheroids are more lens-shaped than a spheroid, and the pseudo-ellipsoids are more spindle-shaped than an ellipsoid. A sharp periphery may develop on the pseudo-spheroid or a sharp point on the pseudo-ellipsoid, in which case streams of matter are ejected through centrifugal force outbalancing gravity.

Considering in detail the figures appropriate to the law $p=\kappa\rho^{\gamma}$, it is found that a sharp periphery will develop on the pseudo-spheroids before the series of pseudo-ellipsoids is reached, if $\gamma<3$ (approximately). Thus a mass of ideal gas for which $\gamma<1\frac{2}{3}$ can never attain the pseudo-ellipsoidal form and so can never divide into two detached masses. But as the density of an actual gas increases with shrinkage, the ideal laws are departed from. The value $\gamma=3$ is reached, perhaps, at a density of $\frac{1}{4}$ to $\frac{1}{5}$, roughly that of a B-type star. So far, then, a "giant" star can lose matter equatorially, but cannot divide by fission. The

[1] Abstract of the Bakerian Lecture delivered before the Royal Society on May 17 by Mr. J. H. Jeans, F.R.S.

latter process can only begin at about type B. This agrees exactly with Campbell's discussion of spectroscopic binaries.

In an actual star internal ionisation and pressure of radiation must be considered, so that a star of sufficient mass can break up before B-type is reached, and there can be "giant" double stars.

The results obtained fit in well with observation and suggest a simple view of stellar cosmogony.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. G. H. Holcroft has presented to the University a valuable collection of fossils and recent shells which belonged to the late Sir Charles Holcroft.

Dr. J. W. Russell has been elected joint professor of medicine, to succeed Prof. Saundby, whose resignation takes effect on September 30 next. The council has resolved to recommend the court of governors at its next meeting to confer the title of "Emeritus Professor" on Prof. Saundby, "in recognition of his conspicuous services to the University and his eminence in the general field of medicine."

Messrs. A. W. Nuthall and J. T. Hewetson have been reappointed honorary curators of the Pathological Museum, in the sections of surgery and gynæcology respectively, for a term of three years from October next.

OXFORD.—On June 12 the honorary degree of D.Sc. was conferred on Prof. Arthur Schuster, who afterwards delivered the Halley lecture. In presenting Prof. Schuster, the Public Orator (Mr. A. D. Godley) spoke of his eminence in various departments of physical research, deploring the inadequacy of the Latin language for dealing with the technical details of the professor's work in the subjects of electricity and magnetism. He alluded also to Prof. Schuster's services as secretary of the Royal Society, and to the value of his labours to the nation at large.

THE Gilchrist Studentship for Women, of the University of London, has been awarded to Miss B. J. Schlumberger, an internal student, of University College.

PROF. J. G. ADAMI's course of Croonian lectures at the Royal College of Physicians of London begins to-day, and will be continued on June 19, 21, and 26, at 5 o'clock. The subject of the course is "Adaptation and Disease."

A FUND of the value of 2000*l*., to be known as the Osler Testimonial Fund, has been raised by the medical and chirurgical faculty of Maryland; the income will be devoted to the purchase of books for the library of the faculty and for the upkeep of the Sir William Osler Hall.

THE Prime Minister has informed Mr. Fisher that the urgent demand for further accommodation for war staff which must be housed in the immediate vicinity of the War Office and Admiralty necessitates the removal of the offices of the Board of Education. The new quarters of the Board are to be at the Victoria and Albert Museum, South Kensington. A sufficient number of rooms in Whitehall will, however, be retained for the use of the President, Parliamentary Secretary, and Permanent Secretary of the Board and for conferences, deputations, and interviews.

DR. T. BRAILSFORD ROBERTSON, professor of biochemistry and pharmacology in the University of California, has given to the regents of the University of California his patents for the growth-controlling substance tethelin, isolated by him from the anterior lobe of the pituitary body and used to accelerate repair in slowly healing wounds. The proceeds which may accrue from the sale or lease of these patents are to constitute a fund which will be entitled "The University of California Foundation for International Medical Research," and will be expended in the furtherance of medical research, preferably research in the physiology, chemistry, and pathology of growth.

WE have received a letter from the Rev. A. J. Ashley, hon. secretary of the Church Esperantist League, in reference to the paragraph which appeared in this column in our issue of May 31. Mr. Ashley writes:—"Ido stands now about where Esperanto stood in the eighties of last century; it has no literature worth mentioning, while many of the finest works of every great literature can now be obtained in Esperanto." Mr. Ashley is of opinion that Esperanto, having thousands of societies and being used daily by tens of thousands of people, is continually spreading, and that such popular acceptance should be a preliminary condition of any Government support. As regards the teaching of a universal language in schools, Mr. Ashley says that in the Patricroft Council School in Eccles Esperanto is being taught as a regular school subject with great success. An account of this experiment will be found in the June–July issue of the *Esperanto Monthly*, which may be obtained from the secretary of the B.E.A., 17 Hart Street, London, W.C.1.

THE new chemical laboratories at University College, London, have been planned and designed so as to meet the requirements of modern chemical teaching and research, including provision for physical chemistry, in which branch immediate and rapid progress is urgent. The funds for these laboratories have been raised by a committee, of which H.R.H. Prince Arthur of Connaught is the president, and Capt. the Hon. Rupert Guinness the chairman and treasurer. The total cost of the site, building, and equipment will be 120,000*l*. One hundred thousand pounds has already been raised, leaving 20,000*l*. still to be found. In order to facilitate the immediate provision of this 20,000*l*., Sir Ralph C. Forster, Bt., who has already subscribed generously to the cost of these laboratories, has promised 5000*l*. on condition that the remaining 15,000*l*. is raised speedily. Upwards of 700*l*. has already been raised towards the 15,000*l*. required. Those who are anxious to see chemical science in London adequately equipped are invited to assist in completing the sum needed. An appeal has been issued by a sub-committee formed by Lord Glenconner and Capt. the Hon. Rupert Guinness for this purpose. Further particulars may be obtained at the college. Subscriptions should be addressed to Lord Glenconner at the college.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 24.—Sir J. J. Thomson, president, in the chair.—Prof. A. **Dendy** and Prof. J. W. **Nicholson**: The influence of vibrations upon the form of certain sponge-spicules. It has been suggested recently by one of the authors that the positions of the whorls which appear on certain siliceous spicules in the genus Latrunculia may be determined by vibrations to which the spicule is subjected at a certain stage of its development, corresponding, in fact, with the nodal points of a vibrating rod. The object of the present communication is to describe a similar case in a closely allied, but hitherto undescribed, genus, and to subject it to mathematical analysis with the view of testing this vibratory theory. The problem was to determine the

degree of coincidence between the actual positions of the whorls on the spicule and the positions which would be occupied by the nodes in a vibrating free-free rod of shape similar to that of the shaft of the spicule at the moment when the nodes are beginning to develop (*i.e.* at the critical stage). The general problem is that of the nodes in a rod composed of two equal portions, each formed by the rotation of the curve $y \propto x^n$ between $x=o$ and $x=l$ about its axis, and the positions of the nodes are expressed as functions of the index n by the interpolation formula. All the spicules examined correspond very closely with this law of shape for values of n between $\frac{1}{2}$ and 1. Details of ten cases at or near the critical stage are given in the paper, and the conclusion is arrived at that the positions of the whorls, although subject to slight individual variations due to various disturbing factors, agree so accurately with the theoretical positions of the nodes as to leave little doubt as to the influence of transverse vibrations in determining them. An efficient cause of such vibrations may be found in the water currents which circulate with considerable force through the canal system of the sponge.—Prof. J. W. **Nicholson**: The lateral vibrations of bars of variable section. The paper contains a discussion of the lateral vibrations of a bar composed of two equal halves and free at each end. Each half consists of a portion of the solid generated by the revolution of the curve $y=Ax^n$ about its axis, and the fundamental frequencies and positions of the corresponding nodes are investigated for various values of n between o and 1.

Physical Society, May 25.—Mr. W. R. Cooper, vice-president, in the chair.—C. C. **Paterson,** J. W. T. **Walsh,** and W. F. **Higgins**: An investigation of radium luminous compound. The paper contains the results of measurements made on various samples of radium luminous compound during the last two years. Determinations of the brightness of the compound in powder form and when made up into paint, and also after the application of the paint to instrument dials, were carried out; and curves are given showing the rates of decay of luminosity. The radium contents of the compounds were determined by comparison of their γ-ray activities with that of a preparation of pure radium bromide, which is periodically compared with the British radium standard. The various precautions which have to be observed and the corrections which have to be applied in making the various determinations are explained, and the considerations which should govern the proportion of radium employed for practical purposes are discussed.—F. J. W. **Whipple**: The resistance to the motion of a lamina, cylinder, or sphere in a rarefied gas. The investigation is carried out on the assumptions that the free-paths of the particles of the gas are long compared with the dimensions of the moving body, and that the motion, relative to the body, of the particles which rebound from it depends only on its temperature. It is shown that if v, w be the components of velocity perpendicular to the surface of a lamina and parallel thereto, the corresponding components of the resistance are

$$(4+\pi)\sqrt{\frac{3}{2\pi}}\frac{v}{V}p \quad \text{an} \quad \sqrt{\frac{3}{2\pi}}\frac{w}{V}p,$$

where V is the standard (root-mean-square) speed of the gas-particles and p is the gas-pressure. The resistance to the motion of a cylinder or a sphere is found to differ very slightly from the resistance to a lamina occupying the central section. The formulæ are applicable to the problem of the damping of the oscillations of a system suspended in a rarefied gas.—Prof. C. H. **Lees**: The effect of stretching on the thermal conductivity of wires.

PARIS.

Academy of Sciences, May 21.—M. A. d'Arsonval in the chair.—G. A. **Boulenger**: Batrachians belonging to the genus Euproctus, their ethological and phylogenic relations.—M. P. A. Dangeard was elected a member in the section of botany in the place of the late R. Zeiller.—P **Fatou**: Rational substitutions.—L. **Décombe**: The influence of temperature on electrocapillary phenomena. An application of the second law of thermodynamics to electrocapillary phenomena, utilising the numerical results obtained by W. A. Vining and by M. Gouy.—M. and Mme. A. **Laborde**: Remarks on a note of MM. Debierne and Regaud on the use of the radium emanation condensed in sealed tubes. For clinical work MM. Debierne and Regaud have proposed to express the energy given out in terms of the quantity of emanation destroyed during the application. The authors suggest that the mean quantity of emanation present in the sealed tube during the time of application gives an equally exact measure of comparison between the two methods of utilising the energy of radium. Actual cases are worked out according to both modes of expression.—MM. **Massol** and **Faucon**: The absorption of the ultra-violet radiations by the iodine derivatives of methane. Details of the absorption bands produced by tetraiodomethane, iodoform, methylene iodide, and methyl iodide.—Ed. **Chauvenet**: The zirconyl bromides The only definite compounds isolated were $ZrBr_4.ZrOBr_2.8H_2O$ and $ZrOBr_2.3.5H_2O$.—A **Valeur**: An anomaly in the solubility of sparteine. An aqueous solution of sparteine becomes turbid when the temperature is slightly raised, and this effect is still more marked in dilute solutions of sodium carbonate. In the latter case the relation between the concentrations in sparteine and the temperature of turbidity formation has been determined, and between certain limits of concentration the curve expressing the results is a straight line. A method for determining this alkaloid can be based on these experiments.—J. **Bougault**: Acidylsemicarbazides and acidylsemicarbazic acids. The author attributes the constitution, $C_6H_5.CO.NH.NH.CO.NH_2$, to the product obtained by the action of sodium carbonate and iodine on the semicarbazone of phenylglyoxylic acid, whilst for the isomer produced by the action of benzoic anhydride upon semicarbazide chlorohydrate the formula $C_6H_5.C(OH):N.NH.CO.NH_2$ is suggested as most probable.—G. **Mouret**: The existence of a zone of crushed rocks, about 200 kilometres long, in the western region of Central French massif.—Ph. **Glangeaud**: The elements of the relief of the volcanic massif of the Monts-Dore.—L. **Ballif**: The determination of the density of air as a function of the altitude. The method is based on the measurement of the rate of ascent of a free balloon, which need not be recovered. The heights are estimated by simultaneous observations by two observers on the ground.—C. **Sauvageau**: A new type of alternation of generations in the brown algæ (*Dictyosiphon foeniculaceus*).—Em. **Bourquelot,** M. **Bridel,** and A. **Aubry**: The crystallisation and properties of a β-monoglucoside of glycerol obtained by biochemical synthesis. The synthesis of this glucoside has been described in an earlier paper (1915). By solution in absolute alcohol, and partially precipitating with ether and then allowing to stand at a temperature below 6° C. for twenty-one months, the substance has been obtained in the crystalline state. Details are given of its rotatory power and chemical and biochemical hydrolysis. This is the first glucoside of glycerol to be obtained in a crystallised state.—M. **Lièvre**: Stereoradioscopy. The apparatus described has been used with success in the Army Medical Service.—J. **Amar**: The origin and prophylaxy of heat stroke. Heat stroke

is regarded as an intoxication caused by fatigue and favoured by bad oxygenation of the blood.—R. **Dalimier**: Chemical vaccination of arsenical reactions.

May 29.—M. A. d'Arsonval in the chair.—H. **Douvillé**: The Orbitoids of Trinity Island.—J. **Bergonié**: The advantages from the hygienic, economic, and social points of view of a change in the number, time, and importance of meals. It is argued that the main meal of the day should be taken at 7.30 a.m., and a second and smaller meal at 6 p.m. The advantages of such a reduction of meals are set out.—S. **Lefschetz**: The multiple integrals of algebraic varieties.—N. **Kryloff**: Generalisations of the method of Walter Ritz.—J. K. de **Fériet**: The formation of integral equations admitting hyperspherical functions as fundamental solutions.—F. **Schrader**: A map of the massif of Gavarnie and of Mont-Perdu.—G. **Sizes**: The intervals in Hindu and Arabian music.—Ed. **Chauvenet**: The combinations of zirconium with sulphuric acid. Twelve compounds of zirconium with sulphuric acid have been described; the author has only obtained evidence of six of these.—G. **Bourguignon**: Normal chronaxy of the muscles of the lower limb in man. Functional and radicular classification by chronaxy.—Ch. **Dhéré** and G. **Vegezzi**: Helicorubin. This red pigment is found in the bile of the snail. Details of the changes in the absorption spectrum under the influence of various chemical reagents. In slightly acid media it is easily oxidised and reduced, and in the intestine of the snail behaves as a respiratory pigment.—H. **Vincent** and G. **Stodel**: The influence of traumatism on experimental gas gangrene and on the recrudescence of this infection. *B. perfringens* may be injected into healthy tissue without visible effect, but it does not immediately disappear; it is latent for a certain period, and may reappear as the result of a contusion.

June 4.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: The equilibrium of a given homogeneous sandy mass under certain conditions.—P. **Montel**: Conformal representation.—W. **Sierpinski**: Some problems which imply non-measurable functions.—G. **Fayet** and A. **Schaumasse**: Elements of the comet 1917*b* (Schaumasse). The elements are calculated from observations made on April 25 and May 8, 14, and 22.—MM. **Portevin** and **Garvin**: The influence of the velocity of cooling on the transformation temperature and structure of carbon steels.—G. **Arnaud**: Some Microthyriaceæ.—M. **Amar**: Remarks on meal times. A destructive criticism of the proposals of M. Bergonié (see above), the main point of which is that food is not necessarily utilised immediately after it has been eaten. Two main meals at noon and 8 p.m. are regarded as justified from the point of view of experimental hygiene and the laws of human energetics.—L. **Camus**: The time necessary for the appearance of the anti-virulent property of serum is a function of the quantity of vaccine inoculated.

BOOKS RECEIVED.

A Psychic Vigil in Three Watches. Second edition. Pp. xi+233. (London: Methuen and Co., Ltd.) 5*s*. net.

The Mothercraft Manual. By M. L. Read. Pp. xviii+440. (London: G. G. Harrap and Co.) 5*s*. net.

A Pocket Book for Chemists, Chemical Manufacturers, etc. By T. Bayley. Eighth edition: Edited by R. Ensoll. Pp. xvi+425. (London: E. and F. N. Spon, Ltd.) 7*s*. 6*d*. net.

Cotton Spinning. By W. Scott Taggart. Vol. ii. Fourth edition. Pp. xxviii+462+illustrations. (London: Macmillan and Co., Ltd.) 10*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 14.

ROYAL SOCIETY, at 4.30.—Some Cases of Wave Motion due to a Submerged Obstacle: Prof. T. H. Havelock.—The Propagation of Sound in the Free Atmosphere and the Acoustic Efficiency of Fog Signal Machinery: Prof. L. V. King.—The Behaviour of Scattering Media in Fully Diffused Light: H. J. Shannon, F. F. Renwick, and B. V. Storr.—The Theory of Decay in Radio-active Luminous Compounds: J. W. T. Walsh.

MATHEMATICAL SOCIETY, at 5.30.—Some Theorems on the Multiplication of Series: A. E. Jolliffe.—Certain Trigonometrical Series and their Applications to the Theory of Numbers: S. Ramanujan.

OPTICAL SOCIETY, at 8.—Aeroplane Compasses: S. G. Starling.—An Optical Method for Accurately Dividing a Circle into Degrees: Dr. R. S. Clay.

FRIDAY, JUNE 15.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—The Spontaneous Firing of Coal: Dr. J. S. Haldane.—The By-product Coking Process, its History, Development, and Application: E. Bury.—Acetylene Mine Lamps: W. Maurice.

MONDAY, JUNE 18.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Zambezi-Congo Watershed: Major E. A. Steel.

VICTORIA INSTITUTE, at 4.30.—Annual Address: The Distances of the Stars: Sir F. W. Dyson.

TUESDAY, JUNE 19.

ROYAL STATISTICAL SOCIETY, at 5.15.—Statistical Aspects of Inflation of the Currency: Prof. J. Shield Nicholson.

MINERALOGICAL SOCIETY, at 5.30.—The Problem of Sartorite: Dr. G. F. Herbert Smith.—Note on a Curious Case of Devitrification: Dr. A. Scott.—The Meteorites of Simondium, Eagle Station and Amana: Dr. G. T. Prior.

WEDNESDAY, JUNE 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Reduction of Temperature Observations to Mean of 24 Hours, and the Elucidation of the Diurnal Variation, in the Continent of Africa: C. E. P. Brooks.—Autographic Records of the Air-wave from the East London Explosion, January 19, 1917: F. J. W. Whipple.—Some Aspects of the Cold Period, December, 1916, to April, 1917: R. C. Mossman.

GEOLOGICAL SOCIETY, at 5.30.—The Inferior Oolite and Contiguous Deposits of the Crewkerne District (Somerset): L. Richardson.—The Pre-Cambrian and Associated Rocks of the District of Mozambique: A. Holmes.

ROYAL MICROSCOPICAL SOCIETY, at 8.—*Nouria rugosa*, a New Species of Foraminifera from the Faröe Channel: E. Heron-Allen and A. Earland.

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THURSDAY, JUNE 21, 1917.

HISTORY AND MANUFACTURE OF EXPLOSIVES.

Explosives. By Arthur Marshall. Second edition. Vol. i., *History and Manufacture.* Pp. xv+407. (London: J. and A. Churchill, 1917.) Price 2 vols. 3*l.* 3*s.* net.

SELDOM has a book on a technical subject been so fortunate in catching the flood-tide of demand as the first edition of this treatise on explosives. The general excellence of the work, combined with the enormous development in the production of explosives, accounts for the issue of a second edition within two years of its first appearance. As Mr. Marshall points out in his preface, "the war has not caused the introduction of any very novel explosives, despite sensational statements of some journalists."

Although by far the best book written and the most comprehensive in the language, the first edition suffered from some important deficiencies, notably in the small amount of space devoted to nitro-aromatic explosives, and, in the section on materials, to the production of nitric acid and nitrates from the atmosphere, and synthetically. Mr. Marshall makes some apology in his new preface, as follows: "Picric acid, trinitrotoluol, and other nitro-aromatic compounds were formerly merely by-products of the dye industry, and consequently their manufacture seemed only to call for a brief notice in a work on explosives." It is difficult to reconcile this with the information in the text that picric acid was adopted by the Germans in 1888 for filling shell, and about the same time by England. It was used by us for the first time in war at the battle of Omdurman. Or, again, in the case of trinitrotoluol, which we read was adopted by the Germans in 1902 for shell filling, and by Italy in 1907 and by Russia shortly afterwards.

With reference to nitric acid, we find it stated that "before the war nitric acid made from the air could hardly anywhere compete with that manufactured from sodium nitrate, but the blockade of Germany has altered all this." Certainly before the war Germany had not neglected to obtain extensive interests in processes for the production of nitrates and to develop processes for the synthetic manufacture, so as to be in a position of independence of foreign supplies when the foreseen, or planned, developments should arise. On the question of cost, according to such a high authority as Prof. Thomas H. Norton, nitric acid by the Birkeland and Eyde process of fixation of atmospheric nitrogen was but little more than half the cost of the acid from Chile saltpetre at 1914 prices, and by the Ostwald process, from ammonia obtained from cyanamide in the first place, even less than half.

However, in the new edition, the nitro-aromatic explosives are now comprehensively dealt with and form a valuable section of the work. The first chapter of the section deals with the by-products of coal distillation, including outlines of benzol and toluol recovery, and the two succeeding chapters with the nitro-derivatives of aromatic hydrocarbons and other nitro-aromatic bodies.

This increased matter, together with an outline of the various processes for the direct production of nitrates and nitric acid, a section on colloids, and other minor additions, have made it necessary to issue the treatise in two volumes. The first of these deals with the production of military explosives and the principal explosives of the chlorate, perchlorate, and ammonium nitrate classes, most of the explosives of the latter classes constituting those of special importance in mining.

One of the most important matters in connection with aromatic hydrocarbons, and especially their nitro-derivatives, is that of toxic effect. Mr. Marshall devotes little more than a page to this; an inadequate space, and, in addition, the information is by no means up to date, the principal references being to a report of a French Commission (1912) and the curative measures adopted in Germany, quoted from a work by Escales and a journal of 1908. Workers in this country have unfortunately experienced the toxic effects of some of the nitro-products, and deaths from trinitrotoluene poisoning have been recorded in the public Press. Excellent preventive measures are now enforced by regulation, and this section would have been of greater value had some detailed reference to these measures been included. We do not find any reference even to the beneficial results from milk as a beverage. Of course Mr. Marshall is engaged so far from this country that it is not easy for him to keep informed on many of these current problems.

In the section on smokeless powders there is considerable extension of the information relating to French powders. One is particularly struck with the systematic nomenclature employed. Instability of the simple nitro-cellulose powders has often been marked. In France the process of "radoubage," which consisted in soaking old powders of impaired stability in a mixture of ethyl and amyl alcohols, was given up after the *Iéna* disaster, and "remalaxage," where the powder was reworked with ether-alcohol containing amyl alcohol, introduced, but this also has been abolished for some years. It is recognised that diphenylamine has great advantages as a stabiliser over amyl alcohol, the primary function of such addition being the absorption of oxides of nitrogen, which catalytically accelerate decomposition when once formed.

This second edition is dedicated to Mr. Lloyd George, and an excellent portrait of the Prime Minister appears as a frontispiece. Everyone realises under what a debt of gratitude the country is to Mr. Lloyd George, and in no office more so than as Minister of Munitions, but really one cannot see that the value of a manual on a

technical subject is enhanced by the inclusion of a portrait of one only connected politically as an organiser with the industry. If any technical book is good, a portrait of a celebrity will not help its usefulness or sale; if bad, no one will want it because of the frontispiece. Technical literature might well be exempt from such embellishments.

"THOUGHT-SUBJECTS."

(1) *The Supervision of Arithmetic.* By W. A. Jessup and L. D. Coffman. Pp. vii+225. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5s. net.

(2) *Second-Year Mathematics for Secondary Schools.* By Ernst R. Breslich. Second edition. Pp. xx+348. (Chicago, Ill.: University of Chicago Press; Cambridge: At the University Press, 1916.) Price 4s. net.

(3) *Elementary Dynamics of the Particle and Rigid Body.* By Prof. R. J. A. Barnard. Pp. vi+374. (London: Macmillan and Co., Ltd., 1916.) Price 6s.

(1) A CONSIDERABLE amount of elaborate investigation has gone to the making of "The Supervision of Arithmetic." It might very well have been analysed and the results presented in a small pamphlet. It is not clear why the book has been imported into this country. It can be of no earthly interest or value to the English teacher to know in detail a mass of information such as "the distribution of cities according to per cent. time, exclusive of recesses and opening exercises, devoted to arithmetic." The tables appear to be the kind of thing to which in American educational courses a diploma is awarded. If this be the case, it seems that pretentious theses for a master's degree may be compiled without any real thinking being done.

We are likewise at a loss to conjecture for whose benefit the tables are compiled, seeing that elaborate explanations are attached to so many that carry on the face of them their meaning. It is not always easy to see the object of some of the investigations—*e.g.* what is the point in a table showing the order of teaching the multiplication table in cities according to their population? No doubt we are stupid and old-fashioned, but we feel a pricking in our thumbs when we see certain tables which to the mind of the compilers seem to decide "whether the books are arithmetics or something else." It is only fair to add that they have a haunting suspicion that their task may seem "foolish." Be that as it may, they reach a limit (? superior or inferior) when they present us with tables showing from five elementary arithmetics the words that begin with "s" and with "w," respectively (they *say,* "beginning with *s* and *w*"), and when they tell us that 94 proper names are used 342 times, "Ella and Kate 6 times each, Helen 8, Henry 9, Carl 12, Fred and James 16 each, Frank 24, Mary 27, and John 40. There are in the same pages 224 words beginning with *c,* and these words are used a total of 1403 times." To the being of dim and bounded faculties this seems table-making gone astray. It makes us tired.

Though there is much that is interesting and much that is useful, the ideals do not always seem to us to be wholesome. "Translated into words, the table means that in June the graduate of a grammar school [whatever that may mean] should be able to work correctly in eight minutes twelve examples like that under Test i. [adding nine rows of three figures], in four minutes twelve examples like Test ii. [subtracting two rows of ten figures]," in six minutes twelve sums like 4179×36, in eight minutes twelve sums like $61{,}707 \div 67$, and so on. If the aim is to turn out cheap calculators for business men, we can understand how this will appeal to the commercial instinct, but what a cast-iron ideal for the "graduate of a grammar school," and at what a cost will it be reached!

All this apparatus of statistical stuff appears to be for the benefit of arithmetic "supervisors." *Quis custodiet custodes?* Already the note of revolt has been sounded. We observe that in the last number of *L'Enseignement mathématique* Prof. D. E. Smith delivers his soul on this point: "Unfortunately, our courses on education are so often concerned with measurements of pupils' accomplishment, with statistical curves, and with ephemeral theories based upon limited observations, that teachers of such thought-subjects as mathematics are generally suspicious of their value." We are not in the least surprised.

(2) "The material as arranged in this course opens to the student a broader, richer, more useful, and therefore more alluring field of ideas, and lays a more stable foundation for future work, than does any separate treatment. A great saving of the students' time is effected by developing arithmetic, algebra, geometry, and trigonometry side by side." The first of these statements contains a large claim, but we can say without hesitation that Mr. Breslich's volume is deserving of careful consideration by the teacher of elementary mathematics as a part of general culture. It is conceived on sound lines, and if there are many minor points that invite criticism—*Quot homines, tot sententiae*—the one fact emerges that at the end of a second year the student who has mastered these pages will be in possession of a very satisfactory body of mathematical equipment, and will be fully aware of its practical value in everyday life. His thoughts will be able to play freely, up to a certain point, in three dimensions; he will have acquired something more than a vague idea of the nature of a proof; he will have the feeling that he has assisted in the building up of something definite, and full of meaning, with the aid of tools in the use of which he will see every reason of interest and utility for endeavouring to become more expert. His interest in the great mathematicians

of all ages will have been aroused; he will, no doubt, have drawn from the portraits in the book very vivid and characteristic conclusions as to the personal appearance of men like Klein, Fermat, and Gauss; and, being a lucky American boy, his interest will have carried him yet further to the biographies in the school library. If this is indeed his gain, it is no small acquisition. In most cases it is to be hoped that he will have learned to dispense with the irritating "Why?" which peppers the pages with the doubtful stimulus of a confession of weakness.

(3) Prof. Barnard's volume is very straightforward and is clearly written. The difficulties of beginners are not unknown to him, and in the selection and construction of examples he claims to have borne in mind the advantage of extensive numerical applications and the necessity of constant appeal to fundamental principles. From the outset he brings in the use of limits "as the only satisfactory way of defining such quantities as velocity and acceleration." The advantages of vector analysis are very much in the (Australian) air at the moment, so we have a chapter on the "merest beginnings" of the elements, which is to be regarded as giving "an alternative method of dealing with questions connected with parallelogram laws." The value of what may be called a merely incidental reference to the use of a powerful tool may be questioned. "O the little more and how much it is!" The direct treatment of simple harmonic motion as rectilinear motion under a given law of force is justified by the statement that "it has the advantage that the student is not led to imagine that some special circle has to be thought of in connection with the motion, as is so commonly the case in the common method." About one-fifth of the book is devoted to rigid dynamics. Altogether it is a very interesting endeavour to smooth the path of the beginner who is to continue his study of the subject when provided with the additional weapon afforded by the calculus.

W. J. G.

OUR BOOKSHELF.

The Advanced Atlas of Physical and Political Geography. A New Series of Maps Specially Designed for Schools, Colleges, and Private Students. By Dr. J. G. Bartholomew. Pp. 96+31. (London: Oxford University Press, 1917.) Price 8*s*. 6*d*. net.

AT last a British firm has supplied the atlas for which colleges and universities have been asking for years. For anything between school work and a general reference atlas it used to be necessary to go to Germany. The firm of Bartholomew has now produced something far better than a German atlas, and at a price that would be low even in peace-time. Both in its plan and in its execution the atlas is excellent and is deserving of all praise as the best atlas of its kind that has been published. There are ninety-six plates of maps, each plate 13½ in. by 8¼ in., and a full index of names. Most plates contain plans and inset maps, and all are printed in colours. Every country is shown by an orographical map, which contains also political frontiers, railways, and a considerable number of names. A few countries have separate political maps in addition. All the orographical maps are layer-coloured in brown and green. There are, in addition, vegetation, rainfall, temperature, and population maps for each continent. The fineness of the workmanship and the excellence of the colour-printing are noteworthy and maintain the high reputation of the Edinburgh Geographical Institute. The geological map of Europe and the orographical maps of Ireland and of France with Belgium are three specially fine examples of cartography. Among other features of this atlas it should be noted that the projections of all the chief maps are given, and that there are two plates illustrating projections. The countries of Europe are shown on scales varying from 1:1,700,000 to 1:5,000,000, except Russia, which is on a somewhat small scale. It is an atlas that will do much to promote the very necessary extension of geographical teaching which must be the immediate concern of this country.

R. N. R. B.

Food and Fitness: or Diet in Relation to Health. By James Long. Pp. ix+208. (London: Chapman and Hall, Ltd., 1917.) Price 5*s*. net.

THIS book possesses a topical interest at the present time, inasmuch as it deals particularly with vegetable foods, giving details of their energy-values and cost at pre-war prices. Although the author states that he is not a vegetarian, the purport of the book is an advocacy of vegetarian principles in diet. It is remarked that the knowledge displayed by owners of stock regarding the proper feeding of their animals is much more profound than that which applies to themselves, which is very true. An excellent chapter deals with the most economical foodstuffs, and the cereals and pulses easily take the first place. The author pleads with justice for an increase in vegetable foods and a decrease in animal ones as age advances and for economy, and the qualities and characters of the principal vegetables and fruits are described, together with suggestions on serving and cooking them.

A chapter on the selection of foods, including animal foods, gives many valuable hints, and another gives records of weights of food before and after cooking. Finally, some useful suggestions are given on sleep and how to attain it, and tables of energy-values of the principal foodstuffs per penny cost complete the volume. While the author's advocacy occasionally leads him to make statements which are not entirely correct, the book as a whole contains a great deal of sound and useful information, and the caterer and housewife who wish to economise will glean from it many valuable suggestions.

LETTERS TO THE EDITOR.

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The Origin of Flint.

THE interesting letter of Sir E. Ray Lankester in NATURE of June 7 induces me to offer a brief account of certain experiments I have been making on this subject.

My interest in the origin of flint was aroused by the many fantastically shaped flints like gnarled roots that one comes across when walking over the Downs. These are of many curious shapes, but an interesting point is that when complete there is often one spot which looks like the gutter of a mould.

This suggests that the silica might have trickled through an opening in the chalk held up in colloidal solution by carbonic acid, and then the carbonic acid, combining with the calcium carbonate of the chalk, formed soluble calcium bicarbonate, thus at the same time enlarging the cavity and producing the conditions for the deposit of the silica, which is no longer held up by the carbonic acid, and is precipitated by the crystalloidal calcium bicarbonate now gone into solution. This view is, moreover, supported by the tabular flints referred to by Sir E. Ray Lankester.

If a very dilute solution of sodium silicate be prepared by diluting ordinary waterglass with about 200 times its volume of water, this may be saturated with carbon dioxide without any precipitation, and the solution can be dialysed, so yielding a colloidal solution of silicic acid in carbonic acid.

When a piece of chalk is dipped in this solution nothing happens immediately, but after twenty-four hours a silicic gel appears on the chalk; in the absence of chalk the silicic acid solution keeps for some weeks before passing from its metastable solution over into a gel.

An attempt was then made to simulate natural flint formation by percolating colloidal silicic acid charged with carbonic acid through chalk.

The chalk used was obtained from the South Downs near Jevington. A cubical block was sawn out about 3 in. in the side, a hole was drilled about ½ in. in width and 2 in. in depth, and then a little chalk was scooped away to leave a shallow pit surrounding the hole. Several times daily this was filled up with the dilute silicic acid solution during a period of more than three months, until there was a solid core of silica in the place of the former hole in the chalk. At first the percolation is rapid, but after about a week becomes slower. The silicic acid jelly first formed is very porous, and takes up water readily. Even when a silicic jelly has hardened until it is as hard as and more brittle than glass, it will go on taking up a remarkable amount of dilute silicic acid into its pores, and giving off air-bubbles with a singing noise.

At the end of the experiment the bulk of the chalk was sawn away, and the part containing the deposited silica placed in dilute hydrochloric acid until nearly all the chalk had been removed, leaving just a thin layer at places to show contrast in colour; there remained a cast of the tube and pit at the top resembling in shape a small toadstool with a concave depressed top.

This was insoluble in acid, dark brown in colour, and semi-translucent. It looked like a flint, especially when wet, when it showed up dark brown and semi-transparent against the small amount of chalk that had been left. The only thing lacking was the extreme hardness of flint, for although harder than the chalk and glassy, it crushed under pressure more readily than flint. It still absorbed water, as do flints, and if there were many years of time to spare, it seemed as if it might be possible by such a process to arrive at true flinty hardness.

The process was tedious, and for some reason which I cannot at present understand did not always succeed; an attempt to feed the growth with a wick of cotton threads failed because of an interesting silicification on the fibres which stopped the flow.

BENJAMIN MOORE.

SIR E. RAY LANKESTER'S difficulties as to the origin of flint (NATURE, vol. xcix., p. 283) would be largely removed if it were more generally recognised that the vast majority of flints in all formations, excluding the occasional examples deposited along fissures, are chemical replacements of the limestones in which they occur. Microscopic observation of thin sections has, of course, furnished the most powerful confirmation of this view. The difficulties as to the cause of such replacement are similar in the case of all "concretions" where the original rock-substance has been removed and new material has been substituted. We now know that even iron pyrites may thus replace silicates or quartz, and that massive crystalline ores need not represent the infilling of cavities.

May I refer to some views which would dissociate flints from any special abundance of siliceous sponges along the horizons at which they occur ("The Rhythmic Deposition of Flint," *Geological Magazine*, 1917, p. 64)? The traces of sponges found in flint seem due to the fact that the deposition of the flint has preserved them, while they have been dissolved away from other zones. The paper above referred to may be regarded as a supplement to the general discussion of work on flints in my "Rocks and their Origins" (1912), pp. 38–42.

GRENVILLE A J. COLE.

June 18.

WITH reference to Sir E. Ray Lankester's interesting notes on "The Origin of Flint" in NATURE of June 7, it is worthy of remark that the structure of black flints, referred to as consisting of minute crystals of silica embedded in colloid silica, may indicate the formation of such flints from the gradual crystallisation of silicic acid gels. Many cases of the production of micro-crystals in artificial inorganic and organic gels are known; indeed, these usually break up eventually with the development of such micro- or macrocrystals. The very slow crystallisation of gelatinous silica appears to be due largely to its small diffusion constant and insolubility.

S. C. BRADFORD.

The Science Museum, South Kensington, London, S.W., June 14.

Electric Discharge from Scythe.

ON the afternoon of June 4 I was mowing a heavy crop of grass with the scythe when I noticed a sharp crack occurring during the cutting strokes. The noise did not occur at every stroke, but was sometimes heard three times during a stroke. The noise exactly resembled a high-tension discharge, and I can think of no explanation other than that the blade became charged, due to the friction on the very dry grass. It would be interesting to repeat the experiment in the dark, but I fear the grass would not be sufficiently dry. I may add that I am quite satisfied that the noise did not arise from the snapping of dry stems or from the scythe hitting stones, etc.

I should be interested to hear if any of your readers have had a similar experience.

J. R. PANNELL.

Twickenham, Middlesex.

THE RAMSAY MEMORIAL FUND.

THE executive committee of the projected memorial to the late Sir William Ramsay has now issued an appeal to the public for the sum of 100,000*l.* to carry out its objects. The intentions of the committee are described briefly in the subjoined letter, which we trust will be given earnest consideration and be made widely known among people in the position to give the financial support necessary to establish the memorial on a sound basis. The organisation of the movement for a memorial to Sir William Ramsay was described in an article in NATURE of May 10. The final form to be taken by the memorial will depend upon the fund obtained, but the main objects are the institution of Ramsay Research Fellowships and the establishment of a Ramsay Memorial Laboratory of Engineering Chemistry at University College, London. The sum already subscribed by Sir William Ramsay's friends, and through their private efforts, amounts to more than 14,000*l.* This includes the generous gift of 5000*l.* from Messrs. Brunner, Mond, Ltd.; 1000*l.* each from Lord Glenconner, Sir Hugh Bell, Sir Ralph C. Forster, Sir Robert Hadfield, Mr. Robert Mond, and Mr. J. B. Noble; and 500*l.* each from the president of the British Science Guild (Sir William Mather), Mr. Charles Hawksley, and Miss Lilias Noble.

The projected memorial has been conceived on a scale and in a form not unworthy of the great name it is designed to perpetuate, and it is to be hoped that the scheme will be carried speedily to completion by the good will and generosity of a very large public.

The appeal that is made has three features which deserve remark. In the first place it is perhaps the first crucial test put upon the public which will show how far the public opinion of this country, after the stimulus of things revealed by the war, has come to appreciate the worth of those who lead in the advance of science. In the second place it asks for the endowment of the study of science in special relation to its industrial application by the institution of something new in kind. Everyone admits the supreme importance for industry of a close association between chemistry and engineering. Discussion as to the possibility of a new type of university product in the form of chemical engineers or engineer-chemists has recently been eager, and no advocate has been more persuasive than Prof. Donnan, Sir William Ramsay's successor at University College, London. However opinion may differ on some aspects of the question, all will agree that there is much that may be done in the direction desired, and it will be entirely consonant with Sir William Ramsay's interests and his enterprise that first-rate provision should be made for this new experimental development of chemical education.

Lastly, the appeal, made to the whole country, asks for something that is to exist in substance only in one place. It is greatly to be hoped that this will in no degree impede support. It is very necessary that it should be realised in connection with the highest education that there must be some localisation of special branches, and this is eminently a case of the kind. The particular centre of localisation must be determined by the circumstances of the case. Centralisation in London is not likely to be carried beyond a certain point, but in the present instance it can scarcely be considered as otherwise than appropriate, if only from the consideration that the longest and greatest labours of Sir William Ramsay's splendid career were during the tenure of his professorship at University College.

The scientific world may be confidently expected to give its utmost support to the memorial not only by subscribing to the fund, but also by bringing the scheme before all who are interested in the promotion of national development through science. We trust that the appeal for funds will meet with a ready and generous response from a large public.

A COMMITTEE has been formed with the object of raising a suitable memorial to the late Prof. Sir William Ramsay, K.C.B., F.R.S., by collecting a substantial fund to be utilised for the purpose of promoting chemical teaching and research.

The committee, after prolonged and careful consideration, has resolved to aim at raising a sum of 100,000*l.*, and to devote that sum to two principal objects, viz.:—

(1) The provision of Ramsay research fellowships, tenable wherever the necessary equipment may be found.

(2) The establishment of a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London.

We should hesitate to ask for so large a sum of money in such exceptionally difficult times, were it not that the objects specified are objects of real and urgent national importance. The war has demonstrated in a manner previously unrealised the supreme importance of scientific, and in particular chemical, research to the national life, both in the conduct of the war and in the pursuits of industry and manufacture.

The late Sir William Ramsay was himself engaged up to within a comparatively short time of his death in various important problems concerned with the bearing of chemistry upon the war, and no one realised more complete'y than he the potentialities of the plans which have since been formulated by this committee as a memorial to him.

It is important that the fund should be raised speedily, so that the plans for the laboratory of engineering chemistry and the scheme for the award of fellowships may be prepared before the end of the war, and so that both schemes may begin to operate with as little delay as possible after the return of peace.

Accordingly, we desire, through the columns of your paper, to appeal to friends and admirers of the late Sir William Ramsay, to old students, and to all persons who are interested in chemistry and its application to industry and manufacture, to contribute to this great national and international memorial to the late Sir William Ramsay, and to send their subscriptions to

the hon. treasurers of the Ramsay Memorial Fund at University College, London, W.C.1.

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Glenconner. Treasurer.

June 16.

THE CATERPILLAR ATTACK ON FRUIT TREES.

A GOOD deal has been heard recently about the caterpillar plague on fruit trees. There has undoubtedly been an abnormal attack in many parts of the country, and much damage has been done. In some parts of Kent, Sussex, Herefordshire, and Worcestershire orchards have been denuded of their foliage, and many more partially damaged. In many instances not only has this year's promising crop gone, but the trees have had a serious setback for next season. Apples and cherries have suffered most, but in a few districts plums have been badly invaded; currants also have suffered. In some districts visited much of the fruit was only slightly affected; some orchards well cared for, not at all; whilst others were as bare as in midwinter, and a fresh set of leaves was already appearing.

Most of the harm has been done by the Winter Moth (*Cheimatobia brumata*). In company with it has been a fair sprinkling of the Mottled Umber (*Hybernia defoliaria*) larvæ. Another "Looper" larva has done much harm in parts of Herefordshire, the Pale Brindle Beauty (*Phigalia pilosaria*), and also in Kent and at one locality in Sussex; it is usually worst in plantations near oakwoods. Comparatively few March Moth (*Anisopteryx aescularia*) have occurred. All those mentioned have either apterous or nearly apterous females, and are incapable of flight. A few are, however, carried by the males *in copula*. From several localities in Kent and Sussex numbers of Clouded Drab Moth (*Taeniocampa instabilis*) have been received; this insect appears to be becoming more harmful to fruit in the south of England.

The main damage done has clearly been due to the insects mentioned, by far the greater part by the Winter Moth, the Pale Brindle Beauty having been very harmful in a few localities only. These caterpillars have now done most of their work, but the fruit-grower is still being harassed to some extent by the Lackey Moth (*Clissiocampa neustria*) and the Little Ermine (*Hyponomeuta padella*). How far these attacks will develop it is impossible to say.

The amount of loss has been due very largely to the serious lack of labour. Many plantations have been improperly cultivated or, from lack of labour, not cultivated at all. It has too often been quite impossible to spray the trees, and even last year there were not sufficient men on many farms effectually to grease-band them. For Winter Moth and its allies two methods of treatment meet with complete success, if properly carried out, which can only be with the necessary supply of skilled labour. The first is grease-banding; the second, spraying with arsenate of lead, where the former cannot be done, as on bush trees or where such pests as the Clouded Drab Moth occur. If grease-banding on standards and half-standards is to be of any use, the bands must remain sticky from October to April, and the bands must be complete, not, as the writer has seen this year, with many breaks in them. If arsenate of lead spraying is done, then, it must be carried out at the proper time and thoroughly. Many growers have sprayed when they found the blossom trusses going and the leaves fast disappearing. This is too late, for the damage is done, the caterpillar working most rapidly towards the close of its life. Apples should be sprayed as soon as the buds are well open, and may have to be sprayed again when the blossom trusses begin to expand. One good spraying as soon as the young "Looper" larvæ are seen will save the crop, whilst to spray when all the damage is done is waste of time and money.

Most of the loss this season to apples and other fruit could, and doubtless would, have been saved had proper provision been made for the necessary skilled labour.

One other point is worth mentioning, namely, that during the winter in many districts there was a great mortality amongst sparrows. The sparrow, especially when nesting, devours Winter Moth larvæ and undoubtedly helps to keep them in check, which, however, will not make up for its many evil habits.

Fred. V. Theobald.

PROF. T. McKENNY HUGHES, F.R.S.

THOMAS McKENNY HUGHES, Woodwardian professor of geology in the University of Cambridge, died at Cambridge on June 9, in his eighty-fifth year.

Hughes was born at Aberystwyth, and was the son of the Rev. Joshua Hughes (afterwards Bishop of St. Asaph), and grandson of Sir Thomas McKenny, Bart., who took a prominent part in promoting Catholic emancipation in Ireland. His brother is Bishop of Llandaff. On leaving school, he entered Trinity College, Cambridge, where he graduated in 1857, proceeding to the M.A. degree ten years later. When an undergraduate he attended the geological lectures of his predecessor in the Woodwardian chair, Prof. Sedgwick. In 1860 he was appointed secretary to the British Consul at Rome, and during part of that and the following year was left in charge as Acting Consul; but before the year 1861 closed he definitely gave up diplomacy for geology, and joined H.M. Geological Survey. He was a member of the Survey until 1873, when he was elected to the Woodwardian professorship. From that date until his death his time and energy were devoted to the cause of the Cambridge

School of Geology, with a success which is fully proved by the high position which that school now occupies.

Hughes's life-work may be conveniently regarded under two heads: his original work in geology and archæology, and his labours in connection with the Cambridge School. The greater part of his geological researches was carried out during his period of service on the Geological Survey and the earlier part of that of his occupancy of the Woodwardian chair. The duties of his professorship became heavier as time went on, and the output of geological papers naturally diminished, though it by no means ceased. During this time he found a pleasant relaxation from official work in archæological study, and enriched many archæological journals with contributions of considerable interest and value, many of which dealt with the antiquities of the Cambridge district.

His most important geological writings were concerned with some of the earliest and the latest deposits. He took a prominent part in the establishment of the pre-Cambrian age of certain rocks of North and South Wales, and wrote much of value concerning the Lower Palæozoic rocks of the Principality and of the borders of Lakeland. He was greatly attracted by the many vexed questions connected with the Glacial and post-Glacial deposits, especially those bearing upon the problem of the antiquity of man: here, also, he added much to our knowledge.

The value of Hughes's work was gracefully recognised by Sir Archibald Geikie when, as president of the Geological Society, he presented Hughes with the Lyell medal in 1891:—"You have not confined yourself . . . to the rocks of any one system or period, but have ranged freely from Archæan gneiss to raised beach, hovering for a moment here and resting a little there, generally critical, almost always suggestive, and with that happy faculty of enthusiasm which, reacting on younger minds, 'allures to older worlds, and leads the way.'"

Turning now to Hughes's work in connection with the Cambridge School of Geology, one was struck by his many qualities making for success. In addition to his scientific attainments, he possessed an acute instinct for judging character, unbounded energy, and an exceptional degree of enthusiasm, which he retained to the end. Not the least of his qualities were those social ones which, causing him to be a favourite among all ranks, were peculiarly valuable when dealing with those with whom he was brought into contact in his official capacity. He exercised a wise control over his department. Using much judgment in the selection of his subordinates, he ever afterwards allowed them a freedom of action which not only ensured a smoothness in the working of the machinery, but also greatly increased its efficiency. Much of the teaching was left to the lecturers and demonstrators, but his own courses were very attractive and highly appreciated. His qualities as a teacher stood out most prominently when conducting field excursions, whether around Cambridge or in other parts of the country. Few gatherings were more delightful than those at his long excursions, and the amount of knowledge acquired by his pupils was great, for Hughes was at his very best on these occasions.

Hughes was very successful in inducing people to take up the study of geology, and was responsible for the addition of many to the ranks of that body which is now becoming all too limited —that of the amateur geologists. To all students alike he was accessible and ever ready with help in the museum and at his home. Here he was greatly aided by his accomplished wife, who died last year. She was the daughter of the Rev. G. F. Weston, Hon. Canon of Carlisle, and was an able geologist and naturalist.

Owing partly to Hughes's own exertions, partly to his persuasive manner, he left the collections in the Sedgwick Museum, already valuable at the time of his election to the professorship, much enriched by his labours. Especially noteworthy is the collection of building stones, marbles, etc., brought together by Mr. John Watson, M.A., through the professor's influence, for he was fully aware of the importance which economic geology must assume in university study. Not only did he add largely to the collections, but, after many delays, he had the satisfaction of seeing them housed in the magnificent Sedgwick Museum, which, largely owing to his unwearied efforts, was completed and finally opened by King Edward VII. in 1904. Another task which partly fell to him was the writing of the life of his predecessor in office. This was finished in 1891, when "The Life and Letters of the Reverend Adam Sedgwick," by John Willis Clark and Thomas McKenny Hughes, appeared.

For want of space, full notice cannot be taken of his many activities unconnected or only indirectly connected with geology, but mention must be made of his interest in agriculture. He took an active part in the proceedings of the Cambridge and Isle of Ely Chamber of Agriculture, of which he was a past-president.

Some of the positions which Hughes occupied and the honours he received have already been mentioned. In addition, he was a professorial fellow of Clare College, F.R.S., and honorary member of many British and foreign learned societies. He was also a Chevalier of the order SS. Maurice et Lazarus (Italy).

It is interesting to note that Hughes and his predecessor occupied the Woodwardian chair for ninety-nine years.

He leaves three sons, all of whom are serving in the Army.

J. E. MARR.

NOTES.

A MEMORIAL tablet, including a medallion portrait of the late Sir William Ramsay, K.C.B., F.R.S., is to be erected in the University of Glasgow, of which he was a graduate and teacher. The University Court has arranged that the memorial, which is designed by Sir John J. Burnet, shall be placed in a conspicuous position at the entrance to the Bute Hall.

IN order to promote the further development of the dye-making industry in the United Kingdom, the President of the Board of Trade has decided to establish a special temporary department of the Board of Trade to deal with matters relating to the encouragement, organisation, and, so far as necessary, the regulation of that industry. The department will be under the direction of Sir Evan Jones, Bart., who has placed his services at the disposal of the President, and will have the official title of Commissioner for Dyes. The Commissioner will act in close consultation with the various dye-making and dye-using interests concerned. Any communications on the subject should be addressed to:—Commissioner for Dyes, Board of Trade, 7 Whitehall Gardens, London, S.W.1.

WE learn from the *Scientific Monthly* that the Council of National Defence and the U.S. National Research Council have sent six American men of science to England and France to study problems arising out of the war. Members of the party and the subjects in which they will specialise are:—Dr. J. S. Ames, Johns Hopkins University, aeronautical conditions; Dr. R. P. Strong, Harvard University, and Dr. L. R. Williams, assistant health commissioner of New York State, health and sanitation; G. A. Hulett, Princeton University, chemistry of explosives; Dr. H. F. Reid, Johns Hopkins University, scientific map-making and photography from aeroplanes; and Dr. G. R. Burgess, of the Federal Bureau of Standards, metals suitable for guns and rigid dirigibles.

As a result of a long series of experiments an important use for horse-chestnuts has been found in connection with the war, one of the principal results of which will be the liberation of a large quantity of maize hitherto used for another purpose. An appeal has been issued by the Food (War) Committee of the Royal Society for the systematic collection of horse-chestnut seeds during the forthcoming season. It is estimated that every ton of chestnuts collected will be equivalent to half a ton of maize, so that the careful collection of all the available supplies becomes a matter of vital importance. Any quantity up to 17,000 tons of chestnuts per week can be used. An organisation for the collection and transport of this hitherto waste product is being perfected, details of which will be announced later. The work of collecting is one in which many people can render service, as the trees are so universally grown, and gathering the nuts is a matter of no difficulty. Owing to the fine weather during the blossoming time, there is every prospect this year of a heavy crop of chestnuts.

THE President of the Board of Agriculture and Fisheries has appointed an Advisory Committee to consider and report upon technical questions of poultry management and feeding, both in general and in detail, and on general questions of the organisation of the poultry industry, with the view of securing that the readjustment of the industry to war conditions shall be made in the most approved manner. The committee is constituted as follows:—Mr. T. W. Toovey (chairman), National Utility Poultry Society; Mr. Gerald Martin, Ministry of Food; Mr. P. A. Francis, Board of Agriculture for Scotland; Mr. Wilfred Buckley, Agricultural Organisation Society; Mr. Tom Barron, National Utility Poultry Society; Mr. W. G. Tarbet, Utility Duck Club; Mr. Tom Newman, Scientific Poultry Breeders' Society; Mr. C. Longbottom, Northern Utility Poultry Society; Mr. F. M. Youngman, J.P., Framlingham and Eastern Counties Egg and Poultry Co-operative Society; and Mr. G. Tyrwhitt Drake, Poultry Club; also a representative, when required, of the Poultry Research Society. The secretary is Mr. J. R. Jackson, Board of Agriculture and Fisheries, 4 Whitehall Place, S.W.1.

THE Edison medal of the American Institution of Electrical Engineers has been awarded to Mr. Nikola Tesla, for early original work in polyphase and high-frequency electric currents.

ACCORDING to notices in the French Press, the Société des Mines de la Loire has just started the first of two electric furnaces of 500 kilowatts for the manufacture of synthetic pig-iron, utilising current from its own generating station.

APPLICATIONS are invited for the Dr. Jessie Macgregor prize for medical science of the Royal College of Physicians, Edinburgh. The prize is of the value of about 75*l*., and is awarded triennially for the best record of original work in the science of medicine. Candidates for the prize must send their applications before July 23 next.

WITH reference to a paragraph which appeared in NATURE of June 14 (p. 312), the (Italian) General Council of Limited Liability Companies has considered the proposal of the Scientifico-Technical Committee as regards contributions by manufacturers towards the scheme for improving science laboratories in Italy. The manufacturers present at the meeting decided unanimously on an annual grant of 25,000 lire for the object mentioned.

DR. H. R. MILL records, in the *Times* of June 19, that the thunderstorm between 5 and 7 p.m. (summer time) on Saturday, June 16, was, if measured by rainfall, one of the most severe ever experienced in London. More than 2 in. fell over an area measuring ten miles from Barnes to Finsbury Park and four miles from Hyde Park to Willesden Green. At two points within this area more than 3 in. was reported—viz. 3·20 in. at Campden Hill, Kensington, and 3·37 in. at Barrow Hill, north of Regent's Park. Such falls in a short period have only been exceeded in the London area, so far as Dr. Mill has been able to ascertain, by 3·42 in. at Blackheath on July 23, 1903, and by 3·90 in. at Hampstead on April 10, 1878. On June 23, 1878, Mr. Symons recorded at Camden Square a fall of 3·28 in. in about an hour and a half; on Saturday last the recording gauge showed that 2·86 in. fell in two hours, and no heavier rain has been recorded at Camden Square in the thirty-nine intervening years.

THE Geological Survey of Ireland has suffered a further loss in the death of Lieut. Horas T. Kennedy, who was killed on June 6 during the great operations south of Ypres. Lieut. Kennedy was born in London in 1889, but was of Irish parentage. After securing a senior scholarship at Trinity College, Cambridge, and taking a first class in the Natural Science Tripos, he gained, by open competition, the post of Geologist on the Geological Survey of Ireland in 1913. His work lay in the re-examination of the Leinster coalfield, in view of industrial developments in that district. He was also about to undertake the revision of certain Silurian strata in western Ireland, where he would undoubtedly have shown his powers of original research; but he obtained a commission in the North Staffordshire Regiment when war broke out, and was transferred later to the Royal Scots Fusiliers. During a short period of leave in the autumn of 1916, he married the second daughter of the Very Rev. C. T. Ovenden, Dean of St. Patrick's, Dublin. His scientific training led to his being attached to the Royal Engineers at the close of that year. He was keenly

looking forward to a return to work in his own country at the conclusion of the war, and the loss of his helpful comradeship is deeply felt by his colleagues on the Survey staff.

THE death occurred at Leeds, on June 7, at fifty-nine years of age, of Mr. Samuel Margerison, a well-known Yorkshire botanist and authority on afforestation. Mr. Margerison did valuable work as a member of the Yorkshire Botanical Survey Committee of the Yorkshire Naturalists' Union, and being an enthusiastic and skilful gardener; he was for some time a prominent and active member of the North of England Horticultural Society. As an expert in afforestation, his advice and help were frequently sought by various local authorities, and he had given expert assistance to the Leeds Corporation Waterworks Committee in its scheme for the afforestation of the Washburn Valley, near Otley. At the Bradford meeting of the British Association in 1901 he read an interesting paper on British sylviculture, in which he pointed out the great importance of maintaining an adequate supply of native timbers. He directed attention especially to the fact that although the natural conditions in this country are not less favourable, the comparison of the results of Continental sylviculture with ours shows that our management is generally inferior, and our forests much less productive. He emphasised strongly the need, in this country, of a sound and effective training in scientific forestry, with adequate practical and scientific equipment, worthy of the subject and of its importance as a national industry.

BOTANISTS will learn with deep regret of the death on May 29 of Dr. Sarah M. Baker at the early age of twenty-nine. Dr. Baker was a student of University College, London, from 1905. She graduated in science (chemistry and botany) in 1909, and proceeded to the D.Sc. in 1913. For five years she had held the position of Quain student in the department of botany, and was shortly to have been appointed to a new lectureship specially created for her. The investigations which she completed in a relatively short period of activity tend to emphasise the loss which science has sustained. Her paper entitled "Quantitative Experiments on the Effect of Formaldehyde on Living Plants" (1913) shows her mastery of biochemical technique, and may serve as a model of what such an investigation should be. It was in connection with this work that Dr. Baker devised the very ingenious automatic waterer whereby the culture-plants could be raised from seed and grown on for long periods without interference of any kind with the progress of the experiment. This contribution was followed by researches on osmotic phenomena, with especial reference to the mechanism of entry and transport of water in plants. Dr. Baker was led to the assumption of both hydro- and aero-permeable regions in roots, the former admitting the nutrient salts, the latter vapour which underwent condensation. Her preliminary paper "On the Liquid Pressure Theory of the Circulation of Sap in Plants," as was to be expected, met with a good deal of criticism. The full paper dealing with this work was only recently completed and will, it may be hoped, be published shortly. In addition to these, there was a series of four papers on the ecology and biology of brown seaweeds, based on field investigations carried out at her father's country cottage at Mersea Island, at Blakeney Point, and elsewhere. The drawings which illustrate some of these are fine examples of line work, deserving of the highest praise. It was characteristic of Dr. Baker to throw herself ardently into whatsoever she undertook. Thus for the purpose of a public lecture recently delivered on vegetable dyes, she worked through the whole chemical basis of the subject, and was not content until she had discovered a number of new dyes by the employment of mordants not previously used. At the time of her death she was investigating critically the bread-making value of a number of substitutes for wheaten flour. Dr. Baker had many interests outside her scientific work, and it is possible that the cumulative draft on her energies may have hastened her death. Her loss will be felt as a personal bereavement by all her colleagues and pupils.

UNDER the title of "Thirty Years' Work of the Geographical Society" Dr. J. Scott Keltie gives, in the *Geographical Journal* for May, a charming sketch of the earlier "stalwarts," scholars, and explorers who have during that period contributed to the advance of geographical science. He dealt in detail with the most important developments during the last thirty years, and he pointed out the progress made by the society. The membership has increased from 3370 to more than 5000; its income from 8600*l.* to 13,000*l.*; and its library from 20,000 volumes to about 66,000. The want of accommodation for its members and collections has been met by the removal of the headquarters from Savile Row to Lowther Lodge. On the whole this instructive review marks a steady advance in the popularity and influence of this great society, on which the council and its officers deserve warm congratulations.

IN *Folk-lore*, vol. xxviii., No. 1, for March last Dr. R. R. Marett, who has done admirable work in guiding the Folk-lore Society during the inevitable difficulties resulting from the war, devoted his presidential address to a review of two pioneers of the society's work who have recently passed away—Sir E. Tylor and Sir L. Gomme. He pointed out that these two scholars, working on somewhat different lines, aimed at the same object, and that their work was in a true sense complementary. He contrasted the two phases of thought, the ethnological and evolutionary schools, which now occupy the field. He showed that the problem of culture-contact in its varied forms is now of primary importance, particularly in its bearing on the origin of the folk-tale. He suggests an eirenicon between the "diffusionist" and the "casualist" schools, the one advocating the origin of tales from a single centre, the other fixing its attention on survivals in custom, belief, and ritual which appear as incidents in the stories.

MISS MAUD D. HAVILAND contributes to *British Birds* for June some valuable notes on the breeding habits of the dotterel (*Eudromias morinellus*) on the Yenisei, where she found it nesting both in swampy ground, such as a snipe might choose, and in more typical places, where the ground is dry and stony. Her notes on the simulation of injury made by the brooding birds to draw off intruders from the neighbourhood of the nest are borne out by those of other observers, but we believe her observations on the protective character of the plumage of this species are new. In the same issue Lieut. D. H. Meares records the field-notes of his brother, the late Capt. C. S. Meares, on the nesting habits of this bird in Scotland. While these notes confirm those of Miss Haviland, they supplement them by describing the character of the lining of the nest.

THOUGH we are assured that "after the war" scientific research is to receive substantial aid from the State, there is reason to fear that this aid will be

given with qualifications. In other words, the promise is extended only to investigations calculated to further the ends of commerce. Students of what is commonly known as "pure science" will not only not participate in the grants that are to be made, but they may be called upon to subsist upon even smaller doles than were allotted to them in the pre-war days. Our administrators seem incapable of appreciating the fact that "applied science" has its roots in "pure science," so that if these be starved the tree will of necessity be stunted. This much is well brought out by Principal Charnock Bradley in a presidential address delivered in 1915, and printed in the Proceedings of the Royal Physical Society, part ii., vol. xx., which might be read with profit by all concerned in allocating the grants which have been promised.

WE are glad to see that in spite of the strenuous times through which they are passing, our Russian Allies still manage to maintain their keen interest in pure science and to continue the publication of those journals which were recently founded with the view of making Russian investigators independent of German channels of publication. Some months ago we noticed the appearance of the first number of the *Revue Zoologique Russe.* The first volume (for 1916) is now completed, and the second (1917) already begun. The contributions range over a great variety of subjects, including systematic zoology, protozoology, cytology, embryology, and experimental zoology, and there is a comprehensive bibliography of current Russian zoological literature, which affords a striking testimony to the activity of Russian workers. Apparently there is no paper shortage in Russia, and the attitude of the authorities towards scientific publication during the war would appear to be very different from what it is in this country. The majority of the memoirs published in the *Revue Zoologique Russe* are naturally written in the Russian language, but there are a few in French or English, and the Russian papers have French or English summaries. The review should therefore appeal to zoologists in many parts of the world, especially as it contains numerous articles of general biological interest. Amongst the latter we may direct attention to a thoughtful paper by Eug. Schultz, written in French, on the application of experimental psychology to the phenomena of morphogenesis. The review is well printed and illustrated, and we hope that the enterprise of the publishers will be rewarded by a wide circulation.

THE sixth half-yearly review of the world's production, distribution, and consumption of fertilisers issued by the International Institute of Agriculture in March last is an interesting commentary on the influence of the war upon this important group of industries in the past year. Mineral phosphates, of which the production in 1913 amounted to roughly 6 million tons, and in 1915 to $3\frac{1}{2}$ million tons, fell still further to 2·8 million tons. The decrease as compared with 1915 was due entirely to a great drop in the American production, which for the first time fell far below that of North Africa. The production of superphosphate showed an even more marked decline on account of the difficulties of obtaining supplies of sulphuric acid. The production and export of nitrate of soda reached the high-water mark of three million tons. The data for sulphate of ammonia are naturally incomplete, being limited to Allied and neutral countries. The British production showed a slight increase over that of the previous year, whilst the production of the United States was the largest on record, being practically 50 per cent. higher than in the previous year.

IN the report of the Board of Agriculture and Fisheries on the agricultural output of Great Britain (Cd. 6277), made in connection with the Census of Production Act, 1906, the output per person permanently employed in agriculture was ascertained to be 90*l.*, counting the farmer in, or 129*l.* if the occupiers were excluded. A general confirmation of this figure, making due allowance for the rise in prices of agricultural produce since 1906, has been arrived at by Mr. C. S. Orwin, director of the Institute for Research in Agricultural Economics of the University of Oxford, in an analysis of the accounts kept at the institute in 1914–15 of six farms of varied type in widely different parts of the country. The results are summarised in the May issue of the *Journal of the Board of Agriculture,* and show an average net output per man (occupiers excluded) of 169*l.* The proportions of the net output assignable to farmer, labour, and landlord worked out at 47·9, 29·9, and 22·2 per cent. respectively, the variation from farm to farm being surprisingly small. The proportions of net *output* falling to the farmer and landlord are subject to considerable deductions before the net *returns* can be arrived at, and a recalculation of the figures with the view of assessing the latter indicated the average share of each interest on all the holdings to be 40·7 per cent. to the farmer, 39·5 per cent. to labour, and 19·8 per cent. to the landlord.

IN a paper read before the Carpenters' Company in London on April 4, published in pamphlet form by the Oxford University Press, Prof. W. Somerville gives an account of forestry in Britain during the last thirty years. Progress, except in increased facilities for education, has been very meagre. "There has been practically no afforestation of fresh land, and what little has taken place has been more than cancelled by the curtailment of the area of previously existing woodlands." Prof. Somerville, believing that national afforestation is essentially a subject for direct action by the State, advocates "the creation of a strong central authority with power to survey and schedule all land that is more suitable for afforestation than for other purposes Experience in the past has unfortunately shown that the Government is apt to seize on any excuse for delaying action, and the country must see to it that directly the survey has revealed a single area afforestation shall proceed." In some cases the capital required for the work would be provided by the Government in the form of a loan. It is not to be expected, however, that private action will do much to clothe with trees the wide stretches of poor pastoral land that constitute the bulk of our afforestable area, and purchase outright by the State would seem in this case to be the only practical procedure, or, as an alternative, the owner might be given the option of granting a perpetual lease to the Government, receiving an annuity as rent. While most of the land would probably be obtainable by mutual agreement, the State must be provided with compulsory powers to be used where necessary.

THE fossil fishes in the United States National Museum, Washington, have lately been arranged by Dr. C. R. Eastman, who publishes notes on some of the specimens in a new part of the Proceedings of that museum (vol. lii., pp. 235–304, plates 1–23). American geologists appear now to be satisfied that the fragmentary fish-remains discovered by Dr. C. D. Walcott near Cañon City, Colorado, are really of Ordovician age, as originally claimed by him; and equally old fragments are now recorded both from the Bighorn Mountains of Montana and the Black Hills of South Dakota. Most of the specimens are too much

broken for exact determination, and Dr. Eastman has not attempted any new study of them; but he describes a small dermal plate of Astraspis, which he compares with the median dorsal shield of the European Devonian Psammosteus. Among Lower Carboniferous remains from Missouri he identifies an interesting new form of the supposed Chimæroid head-spine, Harpacanthus. Triassic fishes are well represented in the collection, and parts of the trunk apparently of a new species of Lepidotus are described from Utah. The Jurassic and Cretaceous fishes are scarcely noticed, but there are several brief descriptions of American Tertiary fishes illustrated by well-reproduced photographs.

A COMMUNICATION has reached us from Messrs. Bellingham and Stanlev, Ltd., in which attention is directed to an interesting point in connection with the design of the Zeiss Abbe refractometer. It has been observed recently by users of the instrument that, owing to want of illumination, measurements cannot be made for liquids having a refractive index greater than 1·52. It is plainly stated in the Zeiss catalogue that the Abbe refractometer may be used for the measurement of refractive indices from 1·30 to 1·7, and that the liquid to be examined is enclosed between two prisms of flint glass. In the instrument as actually constructed it appears that a crown glass prism of low refractive index ($N_D=1·52$) has been substituted for the dense flint prism ($N_D=1·75$) used at first as the lower or illuminating prism. The contact surface of this prism is left unpolished, so as to scatter the light entering the liquid film. The process of wiping the surface to remove the liquid which has been examined results in the removal of the thin sharp walls left by the abrasive, and the surface approximates to a polished face. When this is the case very little light can fall on the contact surface of the liquid and the upper prism at angles greater than the critical angle unless the lower prism has a refractive index greater than that of the liquid under test; for it is only when this condition is satisfied that light entering the liquid is bent away from the normal. Several such instruments have been rendered serviceable for the measurement of liquids of refractive index as high as 1·70 by replacing the crown illuminating prism by a suitable dense flint prism In using the refractometer for solid and plastic bodies it would be more convenient if the prism box were designed to open away from the operator.

Engineering for June 8 contains an illustrated account of the reconstruction of the Union Pacific railroad bridge at Omaha. The new bridge consists of four through Pratt-riveted chord spans, 246 ft. long, one through riveted span 130 ft. long, and two through Pratt-riveted spans 120 ft. long, four deck-plate girders 67 ft. long, and two deck-plate girders 50 ft. long, for two tracks. The total length of the bridge is 1722 ft., excluding approaches; the total weight of the new bridge is about 11,250,000 lb., as against 5,500,000 lb. in the old bridge replaced. The new bridge rests on the original piers, and, in order to interfere with traffic as little as possible, the following method of reconstruction was adopted. The original piers were extended on the up- and down-stream sides by temporary timber piers. The new spans were erected complete on the temporary down-stream piers. The bridge was closed for traffic shortly after 11 a.m. on December 23, 1916, and by twelve o'clock the old spans had been rolled on to the temporary up-stream piers. The new spans were then rolled into position on the piers, this work being completed by 4 p.m. Track crews then closed up the tracks, and signalmen bonded the joints so that automatic signals were restored to operation immediately. Traffic over the bridge was restored at 9.39 p.m. The design and construction of the new bridge have been handled under the direction of Mr. E. E. Adams, consulting engineer of the Union Pacific system.

THE valuable scientific work carried out by Australian men of science is conspicuously shown in the thirty-ninth volume of the Transactions of the Royal Society of South Australia (1915). More than 800 pages, illustrated by seventy plates, are occupied by papers in various departments of science. Most of the shorter papers deal with zoology or botany, but geology and astronomy are also represented. Among the longer papers are notes on the "Fishes of the South Australian Government Trawling Cruise, 1914," by E. R. Waite and A. R. McCulloch; an account of the "Natives of Mailu, Papua," by Dr. B. Malinowski; and "Scientific Notes on an Expedition into the North-western Regions of South Australia," by members of the expedition. The report of the society also records its activities in the popularising of scientific studies by lectures, exhibitions, and excursions, in the discovery of new animals and plants, and in the preservation of Australian fauna and flora. The committee and members of the society may be congratulated on their fine record.

A TREATISE on "Gyrostatics and Rotational Motion" by Prof. Andrew Gray is in the press, and will be published by Messrs. Macmillan and Co., Ltd., as soon as present circumstances permit. The work aims at giving a complete account of tops and gyrostats, gyrostatic action in machinery, and gyrostatic appliances. The general theory is fully dealt with, but an attempt has also been made to treat all the more important special problems by direct reference to first principles in each case. Mathematical difficulties are not avoided. but the relative importance of physical ideas has been kept in view and enforced by careful descriptions of the latest practical gyrostatic inventions, so far as the public service permits.

MESSRS. O. DOIN ET FILS, of Paris, have begun the publication of a series of handy volumes entitled "Bibliothèque de Biologie Générale," under the editorship of Prof. M. Caullerv. Up to the present two works have been issued, but volumes have been arranged for dealing respectively with Les Phénomènes vitaux; La Cellule (Morphologie et Physiologie), Prof. M. Henneguy; Les Formes larvaires et les Métamorphoses, Prof. C. Pérez; La Reproduction asexuée; La Régénération et la Greffe, E. Bordage; La Sexualité et la Parthénogénèse; Les Corrélations organiques et l'Individualité, E. Guyénot; L'Irritabilité et les Tropismes; Les Mutations matérielles dans les êtres vivants (aliment et milieux nutritifs); Les Mutations énergiques dans les êtres vivants (luminosité, chaleur, électricité, etc.); La Biologie des Pigments, Prof. J. Cotte; Ethnologie et Organisation; Commensalisme, Symbiose, Parasitisme; Les Milieux biologiques marins, P. M. de Beauchamp; La Biologie des eaux douces; Les principaux faciès biologiques terrestres; La Concurrence vitale; L'Hérédité; La Variation; L'Hybridation; L'Espèce; L'Adaptation; La Phylogénie; and Les Théories évolutionnistes.

THE Rede lecture. on "Science and Industry: the Place of Cambridge in any Scheme for their Combination," which was delivered on June 9 by Sir R. T. Glazebrook, and is abridged elsewhere in this issue, is to be published immediately by the Cambridge University Press.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following continued ephemeris of this comet, which is now very faint, is given by Dr. Kobold:—

1917	R.A. h. m. s.	Decl. ° ′	Log r	Log Δ	Mag.
June 22	22 32 14	+23 51·9	0·2273	0·0751	10·2
24	36 6	24 3·5			
26	39 53	24 13·5	0·2282	0·0677	10·2
28	43 35	24 22·0			
30	47 11	24 28·8	0·2295	0·0604	10·2
July 2	50 42	24 34·0			
4	54 7	+24 37·6	0·2312	0·0531	10·1

The ephemeris is for Greenwich midnight.

SOLAR PROMINENCES IN RELATION TO SUN-SPOTS.—It has hitherto been generally supposed that solar prominences are inevitably, or usually, found in close connection with sun-spots and flocculi, but an extended investigation which has been made by Dr. O. J. Lee appears to show that there are no substantial grounds for this supposition (*Astrophysical Journal*, vol. xlv., p. 206). His conclusions are based on the photographs taken with the spectroheliograph of the Yerkes Observatory between March, 1904, and January of the present year, thus covering more than a spot cycle. Only 5·8 per cent. of 4068 prominences of all sizes, which were observed between +45° and −45° of solar latitude, were found in the immediate vicinity of spots, and in the same region only 8 per cent. of the prominences were associated with flocculi in which no spot was observed. On the other hand, 81 per cent. of the seventy-eight filaments observed near the solar limb showed a connection with prominences. A considerable number of the large eruptive prominences occurred either in unmarked regions of the solar surface, or where the surface was roughened. Intensely bright places in areas of flocculi, when traced to the limb, usually showed as jets, and rarely as prominences of any size.

THE ECLIPSING VARIABLE SS CAMELOPARDALIS.—Some interesting results with regard to this variable have been derived by R. J. McDiarmid from a series of nearly 11,000 observations made at Princeton between March, 1913, and December, 1915 (*Astrophysical Journal*, vol. xlv., p. 50). The period is 4d. 19h. 47m. 6·4s., and the visual and photographic magnitudes of the system are respectively 10·15 and 9·9. The depth of primary eclipse is 0·57 mag., and that of the secondary 0·15 mag. The primary eclipse lasts twenty-one hours, and is total for seven hours, while the secondary is annular and of the same duration. The discussion of the observations indicates that the system consists of a large red star of low surface brightness and a smaller white star of a little more than one-third the diameter of the other. The surface brightness of the whiter star is five times that of the larger star visually, and twelve times photographically, so that the smaller star is visually the fainter and photographically the brighter of the pair. The density of the large red star is about 1/200, and that of the smaller white star about 1/12 that of the sun. The combined spectrum is recorded as F?, and it is considered not improbable that the small star is of type A, while the larger is of type G or redder.

HIND'S VARIABLE NEBULA.—The variable nebula N.G.C. 1555 has been photographed by Mr. Pease on seven occasions since December, 1911, with the 60-in. reflector at Mount Wilson (*Astrophysical Journal*, vol. xlv., p. 89). The most prominent feature is a fan-shaped nebulosity, having its apex 25″ south-west of the irregular variable star T Tauri. Two knots near the apex, each with a streamer running southward, are the brightest parts of the nebula. The sides of the fan include an angle of 70°, and are about one minute of arc in length. A curved stream of faint nebulous matter lies to the west of the star, and midway between this and the star is a knot which varies in size and brightness. There is also evidence of very faint extended nebulosity filling the whole starless region in the neighbourhood of the variable star. The photographs show distinct changes in the form and intensity of the nebula, but the available data are not sufficient to establish a relation to the variability of the star. Mr. Adams finds that the spectrum of T Tauri is of type Md, with additional bright lines, and that the parallax is of the order 0·05″ to 0·10″; the bright lines extend beyond the dark lines of the spectrum, and would thus appear to be due to the surrounding nebulosity.

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the General Board of the National Physical Laboratory was held at the laboratory on June 19. The president of the Royal Society, Sir J. J. Thomson, is chairman of the board, and Lord Rayleigh chairman of the Executive Committee.

During the past year the laboratory has been closely engaged, with a largely augmented staff, of whom more than one hundred are women, on a variety of researches and investigations arising out of the war, and has dealt with a greatly increased volume of test work for Government departments. The outstanding feature of the year has been the growth of the gauge-testing work. Nearly the whole of the gauges required for the inspection of munitions are now examined at the National Physical Laboratory, the number averaging about 10,000 weekly. By arrangement with the Ministry of Munitions a new building has recently been erected to accommodate the work, the space otherwise available having become quite insufficient for the purpose. There has been a great increase also in the number of optical and electrical instruments tested for the Admiralty; a new branch of work is the testing of luminous dials for instruments of various kinds.

The investigations carried out have been, in the main, of a confidential character, and no details are given in the report. It has only been possible to make progress with a very few of the researches undertaken prior to the war, and these are almost entirely closely connected with war problems. Aeronautics research has continued to be of great importance. The William Froude National Tank has carried out much work for the Admiralty, and has been visited by members of the Board of Admiralty—including Mr. Balfour when First Lord—who have expressed much appreciation of the results attained. In the metallurgy department researches on light alloys and on optical glass have been continued, while a number of special problems have been dealt with. Various investigations have been in progress in the engineering department; hardness tests, methods of impact-testing, the fatigue resistance of materials under combined bending and twisting stresses, the transmission of heat from surfaces to fluids flowing over them—as in the flow of air over an aeroplane engine—are among the questions examined. The observations on the rate of growth of cracks in the buildings of the Tower of London have been continued. No serious disturbances have been detected.

The laboratory is at present under the control of a General Board and an Executive Committee appointed by the Royal Society and the great technical institu-

tions, and the researches are assisted by a grant from the Treasury. The income during the past year was above 70,000*l*., an increase of nearly 20,000*l*. over that of the preceding year. The major part of this total is received in payments for work done, and this involves a serious financial liability. Much attention has been given recently to the question of the future of the laboratory, and in particular to its relations with the Department of Scientific and Industrial Research, and a scheme will no doubt be arranged whereby close relations with the department will be established.

PEAT AND ITS USES.

CONSIDERABLE interest attaches to a recent article in *La Nature* on "Peat," in view of the increasing attention being paid to the use of this substance to replace coal in countries in which the latter is absent or difficult to obtain. The author of the article, M. Renié, discusses concisely the distribution of peat-beds in the various countries, the treatment (drying and pressing) of peat and its uses. He does not pretend that it can compete successfully with coal, except where freights for the transport of the latter are excessive. The best solution, he suggests, is to transform it on the spot into energy, and to recuperate the by-products. The drying and mechanical treatment must be carefully carried out so as to render the fuel as homogeneous as possible. The pressing operation increases the specific gravity of dried peat from 0·7 to 1·03. The cost of treating is not high. Ekenberg has shown that peat heated for a short time at a temperature above 150° C. loses its gelatinous consistency, and thus allows of its being dried by compression. The final product is usually converted into briquettes without the addition of a "binder."

Peat in the agglomerate form has not, however, proved satisfactory in practical use, and to get over the difficulty the use of peat in powdered form has been proposed, a factory having been opened at Bäck (Sweden) to carry out a process invented by Ekelund, which is kept secret. Special grates have to be used for burning powdered peat, and in steam-raising in boilers large grate areas and closely spaced bars, together with modification of the furnace draught, are necessary.

In connection with the use of peat for steam-raising, the following quantities of steam are raised from 1 kilo of the following:—Compressed peat, 4·3 kg.; "half"-coke, 6·6 kg.; coal, 7·4 kg. Peat can be carburised for the extraction of coke and volatile products, a Ziegler continuous-type furnace being generally used in Germany and Russia. Peat coke can be used for metallurgical purposes, and the "half-coked" peat for steam-raising. Particulars of the process are given in the article. It is also possible to extract ammonia water and tars, the latter giving, on distillation, light and heavy oils and phenol. The yield of methyl alcohol is about 3·7 kg. from a ton of peat, and 3 kg. ammonia sulphate and 9 kg. of acetate of lime.

Peat is successfully used in Sweden, in combination with a gas-producer, for working engines of the "waste-gas" type. From one ton of peat 2000 to 3000 cubic metres of gas, giving from 1200 to 1400 calories per cubic metre, are obtained. As the author points out, special care is needed in purification.

Peat is advantageously used as a litter, owing to its deodorising properties, while during the war the Germans have employed it extensively as a substitute for absorbent cotton for bandages. Its antiseptic properties are well known.

E. S. Hodgson.

SCIENCE AND INDUSTRY.[1]

FOR the past three years war and the consequences of war have dominated our thoughts and compelled our actions. May we not hope now that the time is coming when we shall reap the fruits of the heroic efforts of those who have died that England might live? How can we best learn the lessons of this terrible time and turn the experience we have gained to the future welfare of our country? The question is much too wide and far-reaching to be dealt with in a single lecture, and it is beyond my powers to attempt to handle it in a general manner. I wish to deal only with one aspect.

We realised at a very early date that science was to be an important factor in success, and while against the heroism of our men all that the science of our foes could do proved unavailing, it was clear that bravery and self-sacrifice without the aid which science could bring would fail to give us victory. Let me remind you of some few of the methods in which scientific investigation has aided our cause; they are so obvious as to need little more than a passing reference.

Take flying, for example. Every part of a modern aeroplane is the product of a highly specialised science. In the machine itself, to combine strength with lightness, to select the right material for each part, to design the wings so that they may bear the greatest weight and offer the least resistance to the motion, to give the body ample strength to withstand the shocks of alighting, and yet not weight the machine unduly—all these points and many others have been the subject of long and difficult scientific examination.

At the National Physical Laboratory there are five wind channels continually in use to test on models all the various factors on which the aerodynamic efficiency of a machine depends. Two of these channels are 7 ft. in diameter and nearly 80 ft. in length; in one wind speeds up to sixty miles an hour can be obtained. The model is attached to a specially designed balance, or dynamometer, and the forces it experiences in various positions relative to the wind are measured; from these data the behaviour of the machine in flight is determined. Here Mr. Bairstow and his colleagues have worked out the practical conditions of stability of motion and determined by many ingenious devices the constants which occur in the theory. That theory was first given in a general form by Bryan, the theory of the disturbed motion of a body moving in three dimensions, under gravity, the thrust of the propeller, and the resistance of the air. The quadratic which gives the energy in terms of the six co-ordinates and velocities corresponding to the six degrees of freedom of the body contains twenty-one constants. Conditions of symmetry reduce these in number; the air channel experiments afford the means for determining their values, and thus predicting the properties of the machine. The work at Teddington would have proved of little value without the corresponding full-scale experiments brilliantly carried out at Farnborough by two Cambridge men, E. H. Busk and Keith Lucas, who gave their lives for the cause, and now continued by two other Cambridge men, Farren and George Paget Thomson. The name of Busk is, I trust, to be commemorated in Cambridge by a scholarship founded in his memory by friends who admired his powers and loved the man.

But it is not only in the structure of the aeroplane that science has done its part. The engine brought problems of the highest complexity, which are being

[1] From the Rede Lecture, delivered at Cambridge on June 9 by Sir Richard Glazebrook, C.B., F.R.S.

solved by patient application and earnest endeavour. Large powers are needed; the various parts move at great speed, hence strength is essential, but the weight must be kept down; at the same time endurance is necessary; risk of untimely failure must be reduced and the pilot made as secure as possible. Here the metallurgist has been at work, producing alloys little heavier than aluminium, yet comparable in strength with steel, and suitable for many new demands, and in this field Dr. Rosenhain, of the National Physical Laboratory, has arrived at many important results.

Or consider the instruments the pilot needs to determine his height, his speed, or the direction in which he is moving to enable him to drop his bomb at the right moment, or to sight his gun on his enemy as the two planes come within range. Cambridge, as represented by Horace Darwin and Keith Lucas, has done yeoman service in these various fields, while in all our many discussions on theory we have profited by the great knowledge and the clear thinking of our Chancellor—Lord Rayleigh, president of the Advisory Committee for Aeronautics.

Again, turning to another subject, consider the science involved in the manufacture of a big gun and its ammunition, or in the calculation of the trajectory of its projectile. Many gun problems are not new; artillerists had long realised the importance of experiment and calculation, the manufacturer to test his steel and determine the safe stresses to which it could be subject, the gunner to measure the resistance to the motion of the shell to plot its trajectory, determine its time of flight for various ranges, set his fuse, and design his sights so that his shooting might be accurate. But the long-range gunnery of our modern ships and the high-angle fire required for anti-aircraft work, have each introduced new difficulties, and in solving these Cambridge men, such as Littlewood, Hill, Richmond. Herman, Gallop, and Fowler, have been well to the fore, while for anti-aircraft work the Bennett height-finder in one of its many forms is in general use in the Allied Armies.

One striking feature has been the development of methods of accurate workmanship. With some few exceptions all the gauges for munitions pass through the National Physical Laboratory. About 400,000 have been dealt with in the last eighteen or twenty months. At first we were in despair. The limits of accuracy which the inspection department fixed were extremely narrow—in some cases only three ten-thousandths of an inch. Rejections were very numerous; to supply the requirements appeared impossible, but now gauges are examined at the rate of about 10,000 a week, and some 80 per cent. pass as a matter of course. Some firms get practically all their gauges through. Careful scientific examination of the causes of error, improved methods of manufacture, and a firmer grasp of the essentials have produced this change; the standard of manufacture has been gradually improved, and results at first thought unattainable have been realised.

Physics and engineering would afford many other instances, such as improvements in means of signalling, wireless telegraphy, sound-ranging, and weather prediction.

Chemistry and the biological sciences have contributed more than their full share, and though I cannot claim to speak with first-hand knowledge of the achievements of medical science, I must mention some facts for which I am indebted to the kindness of Surg.-Gen. Sir Alfred Keogh and Col. Webb, who informs me that the annual admission ratio for all causes other than wounds in action in France is approximately 428 per 1000. In the following campaigns the corresponding ratios were:—

Egypt, 1882	2276
Nile, 1884–5	557
Dongola, 1896	892
Nile, 1898	955
South Africa	843
China, 1900–1	933

In France the annual admission ratio

For typhoid fever is	0·9 per 1000.
And for the whole typhoid group of diseases	2·4 ,, 1000.

In South Africa the annual admission ratio

For enteric fever was	130 per 1000.
And for enteric fever *plus* other continued fevers	204 ,, 1000.

The figures speak eloquently of the triumphs of medicine, and the wonderful results achieved by the devotion of doctors and nurses.

The war has brought home to us, in a way that only an event of its magnitude can do, the dependence of the modern world on science and the advancement of natural knowledge; the need, then, is that when peace comes we should use this great power to the full to repair the ravages of war.

A distinction is often drawn nowadays between pure science and industrial science. I saw somewhere recently a protest against the use of the latter term. Science is one, and industrial science—so-called—is the application of the discoveries of pure science to the problems of industry. Huxley wrote long ago:—"What people call applied science is nothing but the application of pure science to particular problems." It is essential that we should remember this, and strive here in the first place for the advancement of pure science

Scientific investigations we may divide into two classes: those in pure science which are directed solely to the advancement of natural knowledge, the discovery of Nature's laws, and those which have for their aim the application of these discoveries to the processes of our everyday life in art, or commerce, or manufacture. There is no need to lay stress in this room on the paramount importance of the first class. The Cavendish professor, speaking recently in London, said truly: "The discoveries in applied science may produce a reformation; those in pure science lead to revolutions."

The Röntgen rays, as Sir J. J. Thomson recently pointed out, were studied first as one means whereby we might hope to learn something of the nature of electricity. They are now the surgeon's trusted guide, telling him how to direct his knife and restore his patient to health and strength. Pasteur's work commenced in an inquiry into the crystallographic differences of certain chemical substances, leading him to the result that certain kinds of chemical fermentation are due to the action of living organisms which are not born spontaneously in the fermenting material, but are derived from infection. Lister seized on this and applied it to medicine and surgery. The medical statistics of the war will show, when they can be prepared, something of what the world owes, measured in lives saved for future work, to these two discoveries; the amount of pain the sufferers have been spared is immeasurable.

Lord Moulton, in his preface to "Science and the Nation," refers with special pleasure to Dr. Rosenhain's essay on modern metallurgy. The foundation of this work rests on Sorby's application of the methods of petrographic research to investigate the properties of meteorites, and on the study of the thermo-electric properties of metals due to Seebeck, Peltier, and

William Thomson. Petrographers had been in the habit of examining the structure of rocks by cutting the sections thin enough to be transparent, and examining them under the microscope. Sorby in 1861 found it was not possible to examine metals thus, and developed the art of polishing the surface and etching it with suitable chemicals, thus bringing out the internal structure. Its application to engineering problems passed unnoticed until the method was independently revived by Osmond in France, and Martens in Germany. Seebeck discovered that when in a circuit of two metals a difference of temperature exists between the junctions, an electric current is produced in the circuit. The strength of this current is a measure of the difference in temperature, and this discovery was applied many years later by Le Chatelier to construct a thermocouple for the measurement of temperature in metallurgical processes. Applying these two instruments of research, metallurgists have now a clear idea of the structure of the more important metals and alloys used in industry, and of the manner in which the properties which fit them for their various uses are related to that structure. The intensive study of pure science, the determined effort to hand on still brightly burning the lamp lighted for us by those who have gone, is perhaps the best contribution which Cambridge now can make to our national welfare.

The great discovery is usually small in its beginnings; it does not at first strike the imagination. The seeds from which the revolution is to come lie hidden in the ground, and the tiny sprout which first appears seems but of small importance. Few besides some students in the universities realised the wide-reaching scope of Maxwell's theory of the electromagnetic field, when it was first published; few, again, picture, when they read of the early experiments of Hertz and Lodge, the future marvels of wireless telegraphy, even in the short years that have passed since Lodge delivered his Royal Institution lecture. The successful applications of science to industry attract a wider notice and gain a fuller recognition. It is given to but few men to carry through the revolution that their own discoveries have produced. James Watt and Kelvin were such men. Pasteur and Lister saw, in some degree, the fruit of their labours. Faraday, on the other hand, died at Hampton Court in the receipt of a Civil List pension. The work of making the discoveries of science available to promote the prosperity and advancement of a nation appeals to others than the great discoverers, and is usually best left in other hands. Let me explain what I mean, even at the risk of some repetition, for I have recently spoken and written more than once on this subject, and, indeed, the applications of science to industry have been the work of the National Physical Laboratory since the twentieth century began.

Speaking at the opening of the laboratory in 1902, his Majesty—then Prince of Wales—said:—"The object of the scheme is, I understand, to bring scientific knowledge to bear practically upon our everyday industrial and commercial life, to break down the barrier between theory and practice, to effect a union between science and commerce," and these words still express our aims.

Various writers have pointed out recently that in this process three distinct stages are generally required. We need

(1) The work of the man of science in his laboratory.

(2) The investigations which go on in a laboratory of industrial research, developing new processes or introducing new products.

(3) The works laboratory proper, controlling the quality of raw materials, or of finished products.

I have spoken already of the work of the student of science in his university or college. Before dealing with the laboratory of industrial research, let me devote a few words to the works laboratory proper.

It is necessary, as I have said elsewhere, to maintain the standard of the output, to secure that the proper grade of material is supplied to the works, to check the instruments in use, and to test the product in its various stages of manufacture. The days are gone by when successful manufacture could be carried on entirely by rule of thumb, trusting to the skill of some trained workman for the success of each delicate operation, when the hereditary instinct passed down from father to son was sufficient to produce each year practically the same results. New processes come which appear likely to improve production or to reduce its cost; the works laboratory serves to test these. New products are suggested, which may or may not have the advantages claimed for them; this can be investigated in the works laboratory, and all these investigations and tests must go on in the works themselves under the eyes of men familiar with the process of manufacture in its every stage.

A distinguished Trinity man, Mr. Michael Longridge, when recently addressing, as president, the Institution of Mechanical Engineers, traced the process by which during the latter half of last century England became the leading industrial nation, and concluded thus:—

"And as the mechanical engineer was responsible in no small measure for the transformation, so he must be held responsible for the maintenance and efficiency of the workshop on which the feeding of the people and the defence of the people against their enemies now depend. He became, and he remains, a trustee of the British Empire. How did he discharge the trust? By humbly seeking knowledge to turn the gifts of Nature to the use of man? By invoking the aid of science to develop the discoveries of the men who had prepared the road to his success? By caring for the welfare of the thousands who were spending their waking hours in his factories? By giving them a fair share of the profits of his business? I think we have the grace to-day to answer 'No.' I think we are willing to confess that our heads were turned by elation at our prosperity, that we were obsessed by admiration of our own achievements; too confident of the sufficiency of our limited knowledge; too contemptuous of the few who tried to throw the light of science on our path; too eager for wealth, and the social influence it could buy in the new state of society; too careless of the needs and aspirations of the 'hands' who helped to make the rapid accumulation of large fortunes possible. And what has been the consequence? For every lapse from the ideal—and there is an ideal even of industrial polity—Nemesis Adrasteia, sooner or later, exacts retribution."

The lesson has now been learnt with more or less completeness, and now each modern engineering works possesses its own laboratory and utilises the teaching of science at each stage of its processes. Cambridge can supply the men who will do this work.

But there is another need. The step between the university laboratory and the works laboratory is a long one. Discoveries do not leave the man of science in a form which can be at once assimilated by the engineer, the shipbuilder, or the manufacturer. Some means are needed to make them available to such men to secure the advantages which come from the growth of knowledge by which alone they may keep in the forefront of their trade. The problem has recently been discussed in a paper by Dr. Mees published by

the Department of Scientific and Industrial Research, and by Dr. Rosenhain in a lecture, delivered at Glasgow, on "The National Physical Laboratory: its Work and Aims." For the industrial research laboratory the plant, etc., must be so planned that it is possible to carry out the necessary operations on a scale comparable with that required in works, and, moreover, the man who carries through the investigation must be not only acquainted with the latest scientific advances in his subject, but must know what is possible in works, and must mould his solution of the problem to harmonise with these possibilities. The undertaking is often more complex than that of the pure man of science. It is one which needs a special laboratory, a special equipment.

As examples of such a laboratory, both of which happen to be at works, I may instance the research laboratory of the Badische Anilin- & Soda-Fabrik, in which the commercial production of synthetic indigo was worked out, or the laboratory of the General Electric Co. of America at Schenectady, where in numerous instances the discoveries of modern electrical theory have been turned to practical use. The Coolidge tube, the most powerful source of X-rays which we possess, is one product of this laboratory. Such also are some branches of the Bureau of Standards at Washington, the Materialprüfungsamt at Gross-Lichterfelde, near Berlin, and, in some aspects of its work, the National Physical Laboratory and the research institutions for glass, pottery, fuel, etc., which are coming into existence as part of the work of the Department of Scientific and Industrial Research.

Thus, the task of an institution like the National Physical Laboratory differs from that of either a university or technical college laboratory or a works laboratory. In the first place, it is not educational; every member of the staff is, it is true, learning continually, yet he is not there to be taught, but to be asked questions and to find the answers. Its functions are primarily to encourage and initiate the applications of science to the problems of industry. It is, in the words of the Order in Council, an institution for the scientific study of problems affecting particular industries and trades. The staff devote themselves solely to this work; their whole time and energy are given to it. They have no educational duties; they are free from the responsibilities of the classroom and the burden of students' exercises. The senior members of the staff joined avowedly with the purpose of applying science to industry; they are prepared to make it their life-work. The juniors retain their posts for some time; thus all acquire a store of experience of the highest value, with a unique knowledge of the technical aspects of industry which it is difficult to gain in any other way. The laboratory has, I trust, acquired the confidence of the technical industrial world, and problems are brought before the staff with the knowledge that they will be handled in a confidential manner by men trained to deal with them. In such an institution it is possible to specialise as to both staff and equipment in a manner which can scarcely be done in a laboratory attached to an educational institution. The whole staff are engaged in applying science to industry; equipment is provided for this purpose only. The needs of the student and the educational value of the apparatus have not to be considered.

I would not advocate that work such as I have outlined should, as a rule, find a place in a university laboratory, but a university has its own task in connection with these laboratories, which, believe me, are a necessity if science is to be freely applied to industry. The universities and technical schools must provide and train the staff, not in the application of science, but in methods of investigation, in the knowledge of scientific truths, in the power of observation, the capacity to interpret the observations they make, and the experimental results they obtain, and, above all, in the desire to discover the truth and apply the consequences fearlessly to their daily work.

Nor is this all. No doubt the number of men engaged in the application of science to industry must increase, but if we are to reap the full advantages science can give, steps must be taken to ensure a wider appreciation of the value of her gifts, the greatness of her powers.

Some knowledge of the meaning of ordinary scientific terms, of the usual everyday processes of Nature —both chemical and biological—of the cause of the simple natural phenomena, and of the general scope and methods of scientific inquiry should be the possession of each undergraduate before he leaves Cambridge to take up his life-work elsewhere. "It is essential," as Prof. Keeble writes in his contribution to "Science and the Nation," "that our statesmen and administrators, our teachers and our poets, know something of the work and method and beauty of science." But how is this to be secured? Mr. Wells, in a recent review of the volume, is severely critical because the authors have not answered this question; the criticism is undeserved, it seems to me, because the authors did not set out with this object. "The time seemed propitious," says the editor, Dr. Seward, "for emphasising a particular aspect of the general question of the interdependence of many phases of national prosperity and a just appreciation of the value of pure science." Still, the question needs an answer. We look forward with some eagerness to the report of the committee, of which Sir J. J. Thomson is chairman, which is dealing with the place of science in education.

Meanwhile, it may not be out of place to hazard some few remarks. I will quote again from the president of the Institution of Mechanical Engineers, who, after pointing out that the education of an engineer must be varied to suit the capacities of different minds, writes thus:—

"And my complaint. It is against the obstinacy of our two most famous universities in retaining Greek as a compulsory subject in their examinations. This reacts upon our public schools, and is a serious handicap on those who, intending to deal with the concrete rather than the abstract in their future lives, yet wish to find their levels in the social life and moral discipline of these two universities. The English public-school boy can generally be relied on to face difficulties, lead men, and keep his hands clean in business. Engineering cannot afford to lose him to satisfy those who rule Oxford and Cambridge in this matter."

To insist on the retention of Greek in the Previous Examination is to close Cambridge to many of those who would profit most by its lessons, who would carry the rich benefits three years' residence here can give to places where at present they never penetrate, and who themselves, in not a few instances, would add to the lustre and the glory of our university.

The study of Greek is not really advanced by its compulsory character. Lord Bryce, in a recent article addressed in the first instance to a classical audience, writes, after a reference to the very few who retain a competent knowledge of Latin and Greek beyond an early age:—"Let us frankly admit the facts. Let us recognise that the despotism of a purely grammatical study of the ancient languages needed to be overthrown," and he continues:—"What is the chief aim of education? How should the mental training fitted to produce the capacities which go to make an educated man begin? First of all by teaching him how to observe and by making him enjoy the power of observation. The attention of the child should from the

earliest years be directed to external Nature. His observation should be alert and it should be exact. Along with this he should know how to use language, to know the precise difference between the meanings of various words apparently similar to be able to convey accurately what he wishes to say."

Then, after distinguishing between the world of Nature and that of man, he discusses how the time available for education is to be divided between these two spheres, urging the need for plenty of knowledge of both to produce a capable and highly finished mind. "No man," he says, "in our day can be deemed educated who has not some knowledge of the relation of the sciences to one another and a just conception of the methods by which they respectively advance." He presses strongly the importance of literary studies because of the service they render to us for practical life, for mental stimulus and training, and for enjoyment, and as an introduction to his views on the claims of the classics, he writes:—"A word must be said on the practical aspect of the matter as it affects the curricula of schools and universities. I do not contend that the study of the ancients is to be imposed on all, or even on the bulk, of those who remain at school until eighteen or on most of those who enter a university. It is generally admitted that at the universities the present system cannot be maintained—we shall effect a saving if we drop the study of the ancient languages in the case of those who, after a trial, show no aptitude for them. For the schools, the problem is how to discover among the boys and girls those who have the kind of gift which makes it worth while to take them out of the mass and give them due facilities for pursuing their studies at the higher secondary schools, so that they may proceed thence to the universities and further prosecute them there. Many of you, as leaders, know better than I how this problem may be solved; solved it must be, if the whole community is not to lose the benefit of our system of graded schools."

And in this connection let me quote a few words from a recent letter in Nature by Mr. M. D. Hill, an Eton master of twenty years' experience. He writes:—"The boys who are best at classics are also best at science. . . . Every intelligent boy must be given equal opportunities in science and languages in the widest sense of the word until he is old enough to show which line of study he can most profitably follow."

Here is a problem which the university must attack at once. I have already pointed out what seems to me the first step towards its solution. Cambridge must open her doors wide to every son of our great Empire who can show that he will reap benefits from studying within her walls any branch of knowledge for which she offers opportunities; this step should be taken without delay. Lord Bryce has indicated, I think, the lines for our future development. Let me briefly outline how they appear to me to run. The university must remain the home of ancient learning, but the course pursued to secure this end must not be such as to demand that Latin and Greek should remain the principal part of the school tasks of all boys. It must train men to be leaders in all walks of life, and not least in industrial pursuits, and this not by undertaking the technical training of the men who go out hence into the world, but by laying a broad foundation of the scientific principles and laws on which technical knowledge, be it of theology, medicine, or law, or of the more modern branches of applied science, must rest. And lastly, but most important of all, it must produce the leaders in every branch of science.

For the highest work of all, be it literary or scientific, the course is fairly simple. Men in whom are implanted the thirst for new knowledge, the power of discovery, the keen logical insight to follow the right path and avoid the wrong, will come to the front helped by the traditions of the past, the enthusiasm and devotion of the teachers, the generosity of our founders and benefactors. Funds, it is true, will be needed, and must be supplied. A man whose researches may produce a beneficial revolution, whose discoveries may prove of untold benefit to mankind, should not depend for a scanty livelihood on the proceeds derived from his yearly cycle of tutorial lectures. Means must be found to increase the endowments of the university for pure research, and funds so expended will in time produce a full harvest.

Let me, however, endeavour to say something as to the steps to be taken to give science its due place in the education of every man. Have we attacked this question in the right manner? and by "we" I mean teachers of science generally.

It is nearly forty years since the present Chancellor asked Sir Napier Shaw and myself to help in his work at the Cavendish Laboratory. Practical physics as a branch of study for undergraduates generally was almost non-existent. Maxwell had inspired a few of the leading mathematicians with the desire to work at the laboratory, but the organised classes were small and their organisation was incomplete. Elsewhere Carey Foster had classes at University College, Balfour Stewart at Manchester; Kohlrausch's book had been published and translated into English some few years previously. Shaw had worked in Berlin under Helmholtz. We commenced the endeavour to systematise the teaching, to devise experiments to illustrate and "prove" fundamental laws and principles, to teach students the reality of many things of which they read in books, and show them that effects do follow their causes in the manner there described.

Laboratory notebooks were written. In due course (in 1885) Glazebrook and Shaw's "Practical Physics" appeared, and, I am glad to say, after more than thirty years of life, is vigorous still. It has been followed by many similar books, and has, I trust and believe, done much useful and important work. A man who is to develop into a physicist must have an intimate knowledge of the existing methods of physical investigation. Measurement is so important a factor in many branches of knowledge that an acquaintance with the fundamental methods of measurement, and skill in using instruments and apparatus, are of the highest value for large classes of men.

But for the great majority the mental food thus offered affords but little nourishment. The teaching of practical physics on these lines fits in with our examination system. Problems can be set and questions asked admitting of definite and precise answers the value of which an examiner can easily assess in marks. A sum in arithmetic is classed as a physical problem because the term "specific heat," or "electrical resistance." is used in stating the question. "Our examination system," says Principal Griffiths, "has endeavoured (but, thank Heaven! unsuccessfully) to kill the soul of science in the rising generation. There is, however, a stirring among the dry-bones, and we are awakening to the fact that science must be taught as if we believed in it for its own sake, that we must teach it as a disciple preaches his religion, and that we must refuse to be bound by the fetters in which tradition has entangled us. If we are to succeed, we must make science a living reality to our pupils, and cease to regard it merely as a convenient machinery for the manufacture of conundrums." We do not really so regard it, any of us teachers, but our methods of teaching and examinations tend to produce this impression. It is clear, I think, that a plan which is excellent for men who intend

to specialise in science is not the one best suited to give to all—"some knowledge of the relation of the sciences to one another and a just conception of the means by which they advance." For the limited class an exact knowledge of the elements is essential. If this exact knowledge is required from all, the majority find the process dull; they get no further than the elements, and when the dreaded examination is over they forget even these, and have no further interest in the subject. Natural science, like Latin and Greek, disappears from their lives.

And so, if this be at all the correct view, an important task for the university is to develop a new method for the ordinary teaching of science, not merely to require that science should be taught, but to discuss and determine how this can best be done, and then to train and send out into the world men capable of doing it. The method will not lend itself easily to "the process of controlling education by examination with a limited time," and if a test of the pupil's knowledge is required, some other plan for this purpose must be devised.

One of the consequences of the war will be a greater appreciation of the value of science. Let us in Cambridge be ready to take advantage of this and help to strengthen our country by raising up a generation which realises to some extent what science has done, and how real progress in nearly every walk of life is inseparably bound up with the advancement of natural knowledge, which in the past the university has done so much to promote.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. H. Jackson, of Peterhouse, has been approved for the degree of Doctor of Science.

LONDON.—The Senate has resolved to institute for external students a B.Sc. degree dealing with the administration and management of urban and rural lands and estates, and a scheme with the necessary syllabuses and regulations is in course of preparation.

OXFORD.—Mr. J. J. Manley, the curator of the Daubeny Laboratory, has been elected to a fellowship at Magdalen College, Oxford, for the prosecution of special researches in physics and chemistry. Mr. Manley's talents as a teacher of practical chemistry have long been recognised by several generations of pupils, a list of some 500 of whom has been recently printed. Among them we note the names of Prof. Soddy and of many well-known younger science teachers. Mr. Manley is widely known for his interesting observations on the anomalous behaviour of delicate balances and by his ingenious devices for increasing accuracy in weighings. A re-investigation of Landolt's work on the apparent change of weight during chemical reaction was the subject of a more recent paper in the *Philosophical Transactions,* and he has lately succeeded in constructing platinum resistance thermometers of a sensitiveness greatly in advance of any that had previously been made. Magdalen College and Mr. Manley are equally to be congratulated on this election, which promises to be of considerable service to the cause of physical and chemical research.

On June 19 the annual report of the delegates of the museum was presented to Convocation. The report directs attention to the fact that the members of the staff and other workers in the museum departments on war service have been further increased. The death in action of Mr. Geoffrey Smith, demonstrator in zoology, is recorded; and details are given of the handing over of a large part of the museum buildings for the use of the Royal Flying Corps. Separate reports from the various scientific departments are added, all of them giving evidence of much activity in spite of the present adverse conditions. The report of the curator of the Pitt-Rivers Museum includes an especially long list of valuable donations.

At the same meeting of Convocation, decrees were passed allowing, under certain conditions, that candidates in the science and other honour schools should be examined in part only of their subjects, and empowering the examiners to award distinction to those who have attained a high standard therein. This provision will apply solely to those whose regular course of study has been interrupted by war service.

The extremely valuable collections of Arachnida, containing more than 1000 types, with the library, notebooks, drawings, and papers in connection therewith, bequeathed by the late Rev. O. Pickard-Cambridge, were gratefully accepted, and ordered to be deposited in the University Museum, and placed in the charge of the Hope professor of zoology, Prof. E. B. Poulton.

THE Maharaja of Benares has founded a gold medal, to be known as the "Lady Chelmsford Medal," for award annually to the best student of the Lady Hardinge Medical College for Women, Delhi.

Two "British Dyes" open research scholarships, each of the yearly value of about 60*l*., are offered in connection with the Huddersfield Technical College. They are tenable for one year, with the possibility of renewal. Applications must reach the secretary of the college by, at latest, July 6.

Two scholarships in naval architecture, each of the value of 90*l*., have been founded by Col. Smith Park, C.B., of Glasgow, for students of the University. The scholars are required to have remained at a secondary school until they have obtained the higher grade leaving certificate, which admits to the University courses for graduation in arts or science.

THE debate in the House of Lords on Tuesday, June 12, dealing with the future policy of the Board of Education so far as it has been foreshadowed in the speeches of Mr. Fisher, was chiefly notable for the views expressed in protest against a too early or undue specialisation in the schools, whilst demanding that science should find its due place in the scheme of education, especially in the great public schools, as a subject of vital importance for the effective training of the citizen, so as to enable him to take a sound view of the questions which arise in modern life. The events of the war, intimate and contingent, have made it plainly clear that training in the facts of science and the inculcation of the scientific habit of mind are essential to the national well-being. The purpose of the schools is, as Lord Haldane well put it, not to make of their pupils Latin or Greek scholars, or men of science, but to make them men, and to develop their humanity in the best and broadest sense. In short, their business is so to train their pupils as to give them a liberal outlook in preparation for such specialised teaching in the classics or in the various branches of science, pure or applied, or in other departments of knowledge, as the universities can offer, or as the various professions may require. In no other way can the public schools ensure the generous training of all their pupils, and especially of those who aspire to take a prominent part in public affairs, or shake themselves free of the incubus of conflicting external examinations. Indeed, not until the older universities cease to retain compulsory Greek as an essential feature in the examination for their most valuable scholarships will it be possible for the public schools to give to science its rightful place in their curriculum. It is now seen to be essential that in the treatment of

most great questions of national policy the principles and facts of science must be accorded their due place. It is satisfactory to note that the Government does not intend, in measures having for their object the reform and development of educational policy and methods, to disturb the basis of the Act of 1902 in respect of denominational education.

THE forty-third annual conference of the Association of Headmistresses was held in London on June 8 and 9. Miss Escott, the president, referred in her address to necessary reforms of the educational system, and to the subjects which should be included in educational schemes for girls. "Science in girls' schools," she said, "ought to be greatly developed as part of a liberal education and with special reference to life around them. It would be in the interest of both science and mathematics if the science teacher had a good knowledge of mathematics, and the mathematical teacher a working knowledge of chemistry and physics. In the beginning of general elementary science it would be very helpful for one teacher to take both the science and mathematics in a form, and it is scarcely necessary to say that in advanced work the mathematical teacher should have a knowledge of physics." Among the resolutions passed was one in favour of the metric system, and another welcoming the formation of the Secondary-School Examinations Council. An educational programme put forward by the Executive Committee, and adopted by the meeting, included the following recommendations:—(1) The complete co-ordination of all forms of education; (2) improvement of the teaching of boys and girls in the upper standards of elementary schools; (3) better provisions for the intellectual, moral, and physical discipline of young persons during the period of adolescence; (4) maintenance allowances for more promising pupils; (5) better salaries and better prospects for teachers; (6) a reduction in the number of examinations which may be taken in schools. "The association further hopes that the leaving age for all pupils in elementary schools without exemption will be fixed for the present not earlier than the last day of the term in which a pupil reaches the age of fourteen years, and that the leaving age may be raised to fifteen within the next few years; that the continued education of young persons who have left school and are below the age of eighteen years may occupy not fewer than twenty hours of the daytime in each week, and may be largely of a general rather than a technical character. That this conference is of opinion with regard to university education that there should be a common standard of entrance, accepted by all the universities of the British Empire, and Greek should not be a compulsory subject."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 6.—Dr. Alfred Harker, president, in the chair.—Dr. E. J. **Garwood** and Edith **Goodyear**: The geology of the Old Radnor district, with special reference to an algal development in the Woolhope Limestone. The district comprises an inlier of Archæan grits and Woolhope Limestone forming an elongated dome bounded by Wenlock Shale. It was regarded by Murchison and the Geological Survey as consisting of Mayhill Sandstone succeeded conformably by Woolhope Limestone, and they attributed the unfossiliferous character of the sandstone and the abnormal facies of the limestone to alteration by igneous intrusions. Dr. Callaway, in 1900, first suggested that the so-called "Mayhill Sandstone" was of Archæan age, and recorded an unconformity at the base of the limestone. The authors confirm Dr. Callaway's views, and give evidence for correlating these Archæan rocks with Prof. Lapworth's "Bayston Group" of the Longmyndian. The unconformable relation of the limestone to the Archæan is established in several portions of the district, while a study of the trilobite and brachiopod fauna of the limestone and included shale confirms the Wenlock age of the deposit. The most interesting fact brought out by a study of the limestone is the important part played in its formation by the calcareous alga Solenopora (of which a new species is described), the deposit constituting by far the most striking development of algal limestone yet recorded from British rocks.—S. S. **Buckman**: Correlation of Jurassic chronology. This paper owes its inception to certain discoveries made by the officers of the Scottish Geological Survey during their investigations of the Jurassic deposits of the Isles of Raasay and Skye. The ammonites and brachiopods were sent to the author for examination, and the sequence of faunas which they disclosed necessarily led to comparison with results obtained in other areas. The paper is chiefly concerned with the Liassic ages hitherto known as Domerian, Charmouthian, and Sinemurian. In all of them there is proposed a considerable increase of the number of faunal horizons indicative of consecutive time-intervals, or hemeræ. One of the most interesting discoveries which have resulted, partly from the great thickness of Scottish strata investigated and collected from, partly from comparisons with, other areas, is that the so-called "*armatum* zone" of the English midlands and that of the Radstock district, of Yorkshire, and of the Scottish Isles are not isochronous, but are separated by a time-interval which corresponds with a thickness of some 300 ft. of deposit in the Scottish area.

Royal Astronomical Society, June 8.—Major P. A. MacMahon, president, in the chair.—A. S. **Eddington**: Further notes on the radiative equilibrium of the stars. In the author's previous paper the calculations had been made on the assumption of an average molecular weight of 54 for the material of a star—representing the hypothesis that the ultimate particles are atoms. He was now convinced that under the high temperatures in question an extreme state of disintegration is more probable, and in the calculations in the present paper the average molecular weight is taken as 2.—Rev. T. E. R. **Phillips**: Micrometrical measures of double stars. Special attention was directed to the rapid motion of Boötis, in which the angle diminishes about a degree in six weeks, while the distance has shown little change during the last few years. He had also specially noted the star 70 Ophiuchi, which shows a small progressive diminution both in angle and distance, while the latter should be increasing. He suggested that in this case there may be evidence of a systematic error due to the changing slant of the line joining the two stars as observed before and after opposition.—Mrs. E. W. **Maunder**: Sun-spots in high southern latitudes. These spots were found on the Cape photographs. Some of them were in more than 60° S. latitude, but they are mostly evanescent; they are also small, and it was often uncertain whether they were real sun-spots, or only "pores," which are found on all parts of the solar surface. But in one case the marking had all the characteristics of a true sun-spot, and on the whole the evidence showed that markings of the order of sun-spots can persist in very high latitudes.—R. A. **Sampson**: Notes on the southern magnitude distribution, with special reference to the Perth astrographic zone. In a recent paper Mr. Seares had contended that the galactic condensation of small stars, arrived at by Chapman and Melotte from a study

of the Franklin-Adams charts, was erroneous, and that the older estimate of Mr. Cooke was nearer the truth. The author concluded that the galactic condensation obtained by Chapman and Melotte does not in the least represent the actual distribution in the Perth zone, −32°. In one section of a recent paper Dr. Halm had dealt with the corrections to the scale of the Cape Photographic Durchmusterung, and Prof. Sampson's paper concluded with a discussion of Dr. Halm's methods and results.

EDINBURGH.

Royal Society, May 7.—Dr. J. Horne, president, in the chair.—Prof. L. **Becker**: The arithmetical mean and the "middle" value of certain meteorological observations. This was a discussion of a large number of temperature observations in Glasgow, in which it was shown that the "middle" value did not agree with the arithmetical mean.—Dr. D. **Ellis**: Phycomycetous fungi from the Lower Coal Measures. Three organisms had been found which could be placed in the Phycomycetes. The first was identical with the organism found by Renault in the French Carboniferous rocks, and named by him *Palaeomycites gracilis*. But there was evidence that the genus was the same as Peronosporites, and it was proposed to re-name the organism *Peronosporites gracilis*. The second was identified as *Peronosporites antiquarius*, previously discovered by earlier investigators. The new material obtained from the Lancashire rocks, taken along with the rock sections in the British Museum, enabled Dr. Ellis to sketch the probable life-history of this fungus. The third organism was new, and was named *Saprolegnites bacilloides*. A full account was given of the characteristic structure of this fungus.—Dr. J. **Tait**: Experiments and observations on Crustacea. Parts iv. and v. In part iv. the author dealt with the structure of Glyptonotus, a large Antarctic isopod taken by the *Scotia* Expedition under Dr. W. S. Bruce. The exceptional size of the animal made it possible to settle certain disputed problems relating to isopod anatomy. The paper also brought out a number of relations between structure conformation and functional use. In part v. it was experimentally shown that the joints in the tail of a lobster or other similar crustacean are so arranged as to obviate change of internal volume during the flapping of the tail.

CALCUTTA.

Asiatic Society of Bengal, May 2.—Dr. A. **Oka**: Zoological results of a tour in the Far East. Hirudinea. Fourteen species of leeches are represented in the collection made by Dr. Annandale in Japan, China, and Siam. Of these, three are described as new. Two of the new species are forms of general interest and have been made the types of new genera. One, which was obtained from considerable depths in Lake Biwa, belongs to the family Glossisiphonidæ, and is remarkable for the curious processes on its proboscis, while the other, which was collected in a small stream on the Peak at Hong-Kong, belongs to the family Hirudinidæ, and is distinguished by the unique character that the furrows separating the somites are deeper and more conspicuous than those separating the annuli.—Dr. N. **Annandale**: Weighing apparatus from the Shan States. The collection described was made in February and March, 1917, in the markets of villages round the Inlé Lake, in the southern Shan States. The weighing apparatus used in these markets is remarkably diverse in construction and at the same time generally primitive in character. The three types to which most simple weighing apparatus conforms are all represented, viz. the scales, the steelyard, and the bismer, or weightless beam.

BOOKS RECEIVED.

Reform in Scottish Education. Pp. 158. (Edinburgh: Scottish Education Reform Committee.) 1s. net.

Baillière's Popular Atlas of the Anatomy and Physiology of the Female Human Body. With descriptive text by H. E. J. Biss. Third edition. Plates by Dr. G. M. Dupuy. (London: Baillière, Tindall and Cox.) 4s. net.

Friendly Intercourse with the Arch Fiend Pp. 72. (Letchworth: The Cloisters.) 6*d*.

British Insects and How to Know Them. By H. Bastin. Pp. ix+129+12 plates. (London: Methuen and Co., Ltd.) 1*s*. 6*d*. net.

Food Gardening for Beginners and Experts. By H. V. Davis. Pp. vii+44. (London: G. Bell and Sons, Ltd.) 6*d*. net.

W. and A. K. Johnston's War Map of Palestine. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 6*d*. net.

Shell Shock and its Lessons. By Prof. G. Elliot Smith and T. H. Pear. Pp. xi+135. (Manchester: University Press; London: Longmans and Co.) 2*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 21.

ROYAL SOCIETY, at 4.30.—Revolving Fluid in the Atmosphere: Sir Napier Shaw.—Absorption Bands of Atmospheric Ozone in the Spectra of Sun and Stars: Prof. A. Fowler and Hon. R. J. Strutt.

FRIDAY, JUNE 22.

PHYSICAL SOCIETY, at 5.—The Determination of Coma from a Central Ray: T. Smith.—Chromatic Parallax and its Influence on Optical Measurements: J. Guild.

MONDAY, JULY 2.

ARISTOTELIAN SOCIETY, at 8.—Relation and Coherence: Miss L. S. Stebbing.

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THURSDAY, JUNE 28, 1917.

THE ELECTRIFICATION OF OUR RAILWAYS.

Electric Traction: A Treatise on the Application of Electric Power to Tramways and Railways. By A. T. Dover. Pp. xix+667+5 folding plates. (London: Whittaker and Co., 1917.) Price 18*s*. net.

IN electric traction the questions that have to be discussed may be broadly classified under two headings—technical and financial. The author touches on the latter class incidentally, and then only because it is impossible to leave financial considerations out of account altogether. In the former class he has not included descriptions of generating stations and transmission lines. Even with these restrictions, however, it is only by the severest compression that he has managed in a single volume to give the necessary descriptions of the line, the rolling stock, the appliances and apparatus used in electric traction, and to touch on most of the technical and theoretical considerations involved. We congratulate the author on having succeeded in writing a treatise which engineers and advanced students will find most useful. He is evidently well read in the literature of the subject, most of which is published in the Proceedings of various engineering societies and technical journals, both in this country and abroad, and is therefore inaccessible to many.

In Britain railway electrification is mainly confined to large cities and their immediate neighbourhood. In most cases this traffic has been stimulated by the necessity of competing with tramcars and motor-omnibuses. Unless the railway companies are content to give up a large fraction of the suburban traffic, they must adopt the expedient of electrifying their lines. This expedient, although costly, has proved successful, and many people wonder why the English railways do not at once set about electrifying their main lines. They say that electrification is bound to come, and point out that morally it is wicked to go on burning coal extravagantly in locomotives, seeing that our coal resources will certainly not last for ever. It will be well, therefore, to point out some of the reasons which are making engineers hesitate.

On suburban lines the stations are close together and the trains are continually starting and stopping. Under these conditions an electric train, owing to its higher schedule speed, can carry a larger number of passengers in a given time than a steam train having equal seating accommodation. The number of signal and train movements required for an electric train entering and leaving a terminus is only one-quarter of the number required for a steam train, and for this reason a much larger traffic can be handled by the electric trains before the traffic in the station gets congested.

For main-line railways the problem is more difficult. The efficiency of a modern steam locomotive is very high, and when it has to haul a fast passenger train over a long distance on a level track it is working at its very highest efficiency. The cost of the electric locomotive that could replace it is very heavy, and when we take into account the interest on the great initial expense of electrifying the line, the saving effected, if any, is very small. If, however, there are heavy gradients on the line or long tunnels, electric traction may prove much the more economical. On a steep gradient the potential energy of an electric train can be converted into electrical energy and pumped back into the line. On the Giovi-Genoa line of the Italian State Railways, for instance, the energy recuperated on the down grade is from 60 to 80 per cent. of the energy consumption by the same train on the up journey. The results of tests on a train equipped with motors connected for "regenerative control" on the Metropolitan Railway in Paris show a saving of 20 per cent. of the energy consumption. In addition, the adoption of regenerative control effects appreciable economies in the maintenance costs of the brake shoes, wheel tyres, and rails. The saving in the rails is an especially important item.

Unfortunately, there are several different electrical systems for railways, of which the most important are the direct-current, the three-phase alternating-current, and the single-phase alternating-current systems. There are numerous able advocates of each of these systems, and they can instance in support of their contentions commercially successful electric railways. It is of vital importance to the future of a railway that it should choose the right system of electrification at the start, for the advantages of interchange of traffic between railways are obvious. In the interests of the country there is a pressing need for standardising an electric traction system as soon as possible, and so we hope that the usual costly period of waiting for the survival of the fittest will be brief. For this reason we welcome books of this type, which will enable railway engineers to appreciate the relative advantages and disadvantages of the various systems and so help them to come to a decision.

The author starts with a short and accurate introduction to the mechanics of train movement. It is an excellent example of one of the practical uses of the theory of dynamics taught in all our schools. We next come to chapters discussing in an instructive way various kinds of direct- and alternating-current motors. The modern methods of testing and controlling them are given. Half-way through the book we come to chapters describing the rolling stock for tramways and railways, electric locomotives, and track and overhead construction for tramways and railways. The last two chapters are on feeding and distributing systems and on substation converting machinery respectively. In addition, numerous examination questions are set, the answers being

given to the numerical ones, and references to the text in the case of the descriptive ones. We have satisfactorily checked some of the calculations, and the book is laudably free from misprints. There is little original matter in the work, but the author shows good judgment and no little knowledge in his selection and treatment of the various branches of this important subject.

We are sorry that the author was compelled by considerations of space to devote little more than half a page to the important subject of lightning arresters. He divides them (p. 279) into (1) the aluminium cell arrester, (2) the spark-gap arrester, and (3) the non-arcing arrester. We usually divide them into (1) the electrolytic, (2) the intermittent, and (3) the continuous types of arrester. Engineers are probably familiar with the devices mentioned, but the non-technical reader will have to look up the references given at the bottom of the page. The numerous references form a useful feature of the book.

A. RUSSELL.

COTTON CULTIVATION IN THE UNITED STATES.

Field Crops for the Cotton-Belt. By Prof. J. O. Morgan. Pp. xxvi+456. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 7s. 6d. net.

THE "Rural Text-book Series" has furnished the agricultural students of the United States of America with several very useful volumes. Prof. Oscar Morgan's contribution now before us worthily upholds the reputation of the series, and is likely to be accepted as having a value considerably beyond the sphere of usefulness very possibly contemplated for it by its author.

Coming from an expert resident in Texas (the most important of the cotton-producing States), the book will be appreciated by cotton-growers throughout the world. In that light it is perhaps unfortunate that so much elementary science was thought necessary. The first principles of the physiology and chemistry of plant life might have been left to the lower school text-book. A glossary of terms would have got over any difficulty presumed to exist and might, at the same time, have been made useful to the general reader not familiar with American agricultural terms and expressions. For example, it is somewhat amusing to find the expression "Irish potato"; tobacco a stimulant; buckwheat a cereal; the "cotton square"; the "Corn-Belt"; the silking of corn, etc.

Setting these minor considerations on one side, there are numerous features of the work of great merit. It is a considered and practical exemplification of the actual conditions and experience of cotton production of the States, framed primarily for use in schools and colleges.

Limitations of space will not permit of a detailed analysis, but it may suffice if we indicate one comparative aspect, namely, between the States and India, as illustrative of the numerous practical bearings of the book. Prof. Morgan describes very fully ten of the associated crops in the Cotton-Belt. The first and most important is corn, or, as in Europe it is more generally called, Indian-corn (*Zea Mays*). This, it would seem, occupies 38 per cent. of the belt, while cotton takes 39 per cent.; then follow (but far behind in point of area) oats, 3·7; wheat, 3·5; kafir and milo, 1·4; pea-nut, 0·9; rice, 0·8; sugar-cane, 0·6; while sweet sorghum, rye and barley show still smaller percentages. Practically all the cotton, sugar-cane, rice and pea-nuts grown in the United States come from the Cotton-Belt.

It may now be useful to exhibit a parallel assortment of the crops associated with cotton in India. Indian-corn, sugar-cane, rice, pea-nuts are not recognised as important crops in, and the Indian supplies of these are not drawn from, the cotton-producing districts. Oats and rye (except on the hills) can scarcely be said to be grown in India. Barley and wheat only occasionally accompany cotton, the former, as a rule, being mainly produced outside the cotton districts. On the other hand, Sorghum (*juar*), Pennisetum (*bajra*), Cajanus (pigeon-pea), Sessamum (*til* seed), Linum (linseed), and *Hibiscus cannabinus* (Deccan hemp) are very closely associated with the Indian cotton.

The Indian crops associated with cotton might be described as a slightly more tropical set than the American, and they denote at the same time differences in soil, climate, seasons of growth, tillage, manuring, and stock—differences that collectively account very possibly for the lower grade of the staple in India as compared with that of the United States. And perhaps the most vital aspect of these differences is the fact that the Indian cotton associates can scarcely be spoken of as rotated with it.

The Indian rotation, such as it is, is usually within the year, not after the lapse of one or more years. That is to say, two crops are taken off the same field every twelve months, one being cotton and the other the alternate crop. Interplanting is also largely followed, more especially with pigeon-pea (Cajanus), or with *juar* (sorghum, but only rarely the sweet sorghum), the balance in the soil being thereby to some extent preserved. Thus, while in India cotton is often grown year after year on the same field, our author tells us that in the States a three- or four-year rotation is universally accepted as essential. Thus: 1, cotton; 2, corn; 3, oats and wheat; and 4, cow-peas.

A study of the book leaves the conviction of its practical utility so deeply impressed that one is constrained to recommend improvement of existing supplies (especially Indian) on the lines set forth by our author as a more rational procedure than the discovery of new areas of production.

The book may be commended to all persons interested in cotton or the associated crops of cotton.

GENERAL CHEMISTRY.

General Chemistry for Colleges. By Prof. A. Smith. Pp. x+662. Second edition. (London: G. Bell and Sons, Ltd., 1916.) Price 6s. 6d. net.

THE second edition of Prof. Smith's "General Chemistry for Colleges" has been entirely rewritten. It now covers nearly 700 pages, and might easily be mistaken for a new edition of the author's well-known "General Inorganic Chemistry." Regarded from this point of view, the book is excellent: a very careful scrutiny would be needed to discover anything of real value or importance that has been sacrificed in the smaller as compared with the larger book, and the student has good reason to be pleased with a condensation which, after eliminating more than a hundred pages of text, has left him with a book that still covers everything that was essential in the original syllabus.

As the title implies, the book is primarily one for first-year college students, and not for schools. A clever schoolboy could, of course, master its contents; but so many "advanced" subjects are referred to, in an abbreviated form, that he would lose much of the benefit of the change of atmosphere which should take place on passing from school to college. The introduction is, however, so much superior in its method of treatment to that of the larger volume that the reader is left with a desire to see it expanded and used as part of a simple introductory text-book.

The author is a whole-hearted ionist and makes the fullest possible use of the theory of electrolytic dissociation. In a footnote on p. 217 he promises that "the objection that separate atoms of sodium could not remain free in water will be disposed of later"; but it is doubtful whether the ghosts of the separate sodium atoms can be finally laid to rest by the somewhat unconvincing incantation on pp. 234-35, which does not differ essentially from that used ten years ago in the larger book. This was based, then as now, upon the original recommendation of Ostwald that the ghost should be laid by an incessant chanting of the blessed word "allotropy." The objection is, however, a real one, and is not met by the mere assertion that "metallic sodium and ionic sodium are, simply, different substances," or the implication that sodium and chlorine ions become or remain separate in aqueous solutions in virtue of the fact that the atoms are provided with equal and opposite electrical charges. The more active part now assigned to the solvent will, no doubt, make it easier in future editions to meet the objections put forward by the student, or occasionally by the conscience of the teacher.

The whole volume bears the impress of the wide range of knowledge and the gift of clear exposition which belong to the author, and it will be widely used and read both by teachers and by students of chemistry.

T. M. L.

OUR BOOKSHELF.

Diderot's Early Philosophical Works. Translated and edited by Margaret Jourdain. Pp. v+246. (Chicago and London: The Open Court Publishing Co., 1916.) Price 4s. 6d. net.

ALL who are interested in the movement of thought which found its expression in the great French Encyclopédie will welcome this translation of some of Diderot's minor philosophical writings. It can scarcely be said that they show much profundity or definiteness of purpose. They were rather "works of occasion"—short pieces thrown off at short notice—mainly with the purpose of filling the author's purse when money, as happened so often, was running short with him. Nevertheless, they give us a pleasing insight into Diderot's eager and inquiring spirit, and his impatience with the religious bigotry which was the deadly foe of all free and honest inquiry. The main philosophical point treated in the volume is the relation between mental development and sensuous endowment, a point on which some diversity of opinion is still maintained. His conclusion is that "the state of our organs and our senses has a great influence upon our metaphysics and our morality"; and he shows in some detail in what directions this influence is exerted. To most modern psychologists Diderot's principle will seem so manifestly true as scarcely to admit of discussion. Nevertheless, the principle has been called into question recently by the New Realists, who argue that the human mind is in immediate contact with objective truth. For the confutation of such views Diderot's acute observations upon a blind man and a deaf-mute of his acquaintance are not without value at the present time.

Elementary Physics for Engineers: An Elementary Text Book for First Year Students taking an Engineering Course in a Technical Institution. By J. Paley Yorke. Pp. viii+165. (Cambridge: At the University Press, 1916.) Price 4s. net.

THE ground covered by this text-book comprises the fundamental properties of solids, liquids, and gases; force, work, and energy; and the elementary principles of heat, including a chapter on the mechanical equivalent of heat and the fundamentals of the heat engine. The author in his preface states that he has "attempted to present some essential facts of elementary physics as briefly and straightforwardly as possible, without any pedantry or insistence on details of no practical importance." While the book contains nothing novel, the matter is readable and the statements are clear and concise. Formulæ and mathematical equations have been avoided to a large extent. There is little in the text to make it peculiarly applicable to engineering students, and compared with some introductory books of physics which have appeared in recent years, the treatment is somewhat sparse. A few chapters are provided with numerical exercises, but no answers are appended. The book is expensive considering the amount of matter it contains.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Chinese and Persian Giraffe Paintings.

IN NATURE of February 18 and July 29, 1915, and in the American *Museum Journal* for last year, figures were published of ancient Egyptian and also of late fifteenth-century representations of the giraffe. To this series of olden-time drawings may now be added one from Chinese sources, dating probably from the early Ming period, a reproduction of which is shown in the accompanying illustration.

The original is a large unsigned painting in dull colours on silk, executed with considerable firmness of style and finish, the trappings and figures of the attendants receiving especial attention. The general style of the painting and the state of preservation of the fabric and colouring would seem to indicate an antiquity of at least three or four hundred years. In the opinion of the owner, Mr. A. W. Bahr, a dealer in Chinese works of art in New York, the painting is still older.

Early Chinese picture of a giraffe.

Through the kindness of Miss Greene, in charge of the private library of Mr. J. P. Morgan in this city, the writer has had the privilege of examining a number of old manuscripts containing animal paintings, among them being one which is probably the earliest known English bestiary. Another is an extremely interesting Persian bestiary of the thirteenth century, which has been briefly noticed by M. Claude Anet in the *Burlington Magazine* for 1913 (vol. xxiii., No. 24).

Among the admirably drawn coloured figures of this Persian MS. is one of the giraffe, which is strikingly like the Chinese painting already referred to. It might almost be said that one has served as a model or general design for the other, and undoubtedly the Persian is the more ancient. The inference appears warranted, therefore, that pictures of the giraffe and other Western animals were introduced into Persia through trade routes so early as the thirteenth century, and thence found their way into China, where they were copied by native artists.

C. R. EASTMAN.

American Museum of Natural History, New York.

The Nature of Renal Activity.

MAY I be permitted to explain what seems to me to be a misunderstanding of Prof. Cushny's position contained in the review of his monograph in NATURE of June 14?

No physiologist at the present time can hold that the kidney is a "mere machine," if by that it is meant that such simple physical and chemical forces as those of diffusion and osmosis are sufficient to give a complete solution of its activity. The fact that the fluid which leaves the kidney has a much higher osmotic pressure than that of the blood from which the fluid was formed shows at once that work has been done by the cells of the organ. In our present ignorance we say that this is by means of the "vital" activities of the protoplasmic mechanism, which transforms chemical energy derived from oxidation of food material into osmotic energy. In using the word "vital," most of us have no intention of begging the question as to whether or not these activities involve more than forces present in the non-living world, acting in a special complex system, however much we may feel that further investigations will show that there is no necessity for the assumption of a form of energy peculiar to living beings.

Where Prof. Cushny's position, as I understand it, is an advance lies in the simplification which it introduces into many aspects of the problem. To put it very briefly, it is this:—In the glomerulus, fluid is filtered from the blood by means of the arterial pressure. This fluid consists of all the constituents of the blood *minus* the colloids, the latter, of course, including the blood corpuscles. It contains all that the final urine contains, but in very dilute solution. So far, this is the view put forward by Prof. Starling, but the further development diverges from that given by Prof. Starling. There are two possible ways in which this dilute glomerular filtrate might be made more concentrated—one by removal of water, the other by the addition of solutes contributed by the secretory activity of the cells of the tubules.

Now Prof. Cushny, after a careful examination of the evidence that has been brought forward in support of the second view, comes to the conclusion that none of this withstands criticism, so that the first method must be the one accepted. But, while previous theories regarded reabsorption of water and that of certain of the solutes as separate processes, the new point of view is that the fluid reabsorbed has the composition and concentration of the diffusible substances contained in the blood, with the omission of certain excretory products, such as urea. As Prof. Cushny puts it, "Locke's fluid" is reabsorbed. Naturally, some reason has yet to be found why urea fails to be absorbed, while sodium chloride, glucose, and amino-acids are, but the whole of the phenomena met with can be satisfactorily explained on this "modern view." For example, sulphates are foreign to the blood, and are not reabsorbed. Whatever is present in blood in true solution is present in the glomerular filtrate, but only the constituents of Locke's fluid (*plus* amino-acids) are reabsorbed and in the concentration present in that solution. Doubtless we shall be able in the future to say why the cells behave in this way. The process may be called "selective discrimination," if any comfort is obtained from doing so, but so may the behaviour of parchment paper towards gelatin and

salts. The point is, as Prof. Cushny shows, that the tubule cells *always* absorb a fluid of the composition referred to, whatever may be the needs of the body at the time. They have no power of choice.

The new view must be welcome to those who wish for simplification. It will probably not appeal to those who hold that this is no advantage to a theory, at all events in biology. W. M. BAYLISS.

University College, London, June 16.

THE expression "mere machine" is Prof. Cushny's, not mine. One is glad to learn from Prof. Bayliss that this is not to be interpreted too literally. We all look forward to the time when the expression "vital energy" can be expunged from our vocabulary, but whether the "modern theory" helps us to the realisation of this ideal renewed research alone can show. That Prof. Cushny's theory is in the direction of simplification is a matter of opinion.

THE REVIEWER.

The Origin of Flint.

SIR E. RAY LANKESTER (NATURE, June 7) does not say what form of carbon he refers to as the colouring matter of black flints. If it be carbon, why is the coloration not extended to the white cortex? The blackest flint nodules I have seen occur in a chalk-pit near Faversham, but the apparently black silica becomes white when powdered, showing it to be merely an optical effect. I believe that Judd was the first to point this out, more than thirty years ago. I refer to the flints obtained direct from the chalk and not to those which, having become dissociated from the parent mass, have been afterwards subjected to the influence of various solutions.

The white zone on the exterior of a flint does not necessarily indicate decomposition. In flints taken direct from the chalk it is due to the fact that the rock contiguous to the nodule has not been wholly silicified. Sometimes nodules in the chalk are white throughout, being formed entirely of soft, crypto-crystalline silica, the spaces between the quartz not being filled with colloid silica. I have found these near Corfe. There is no evidence of decomposition, and I regard them as representing an early stage in the forming of a flint nodule.

Some decomposed flint pebbles found at Southbourne-on-Sea, described by me in NATURE at the time (May 1, 1890), are very similar in appearance, but these results are due to deformation.

Many facts seem to prove that flint has been formed since the chalk became indurated and elevated. The naturally repaired fractured flints found near faults, etc., and the remarkable compound flints which I recently exhibited at the meeting of the Geol. Physics Society, are instances. In some of the latter specimens there are as many as four thick deposits of flint surrounding the original nodule, and as there appears to be little, if any, molecular continuity between the layers, the growth of the compound nodule must have been arrested from time to time during its development in the solid chalk. CECIL CARUS-WILSON.

THE suggestion of Dr. R. M. Caven (p. 306), that the black colour of flint is due to ferrosoferric oxide, is supported by the fact that flints which have been for some time in contact with gas-lime (as when a mixture of these materials is used for road-metal) become stained of a deep blue colour, which has been shown by analysis to be due to ferric ferrocyanide. A discussion on this subject appeared in NATURE in 1904 (vol. lxxi., pp. 83, 126, 176). F. J. ALLEN.

Cambridge, June 24.

A Note on Chaffinches and Cuckoos.

ONE day recently I went to look at a chaffinch's nest which I had known of for some time. I had just begun to climb up the hawthorn-tree in which the nest was placed when I heard the "pink, pink" of an alarmed chaffinch, and immediately about five cock chaffinches and more than half a dozen hens and young ones appeared from what seemed to me nowhere. These chaffinches flew all round the tree in a most agitated manner, and one cock actually got on top of my head and pulled my hair vigorously, while a hen, which appeared with the other chaffinches, and I think was the mate of my assailant, flew on to the nest and pecked at me every time I tried to touch it. Their attack induced me to get down; and not until I was more than fifty paces from the tree did the other chaffinches go away.

Not very long after this I was in the garden when I saw two cuckoos which were flying very low, and I could clearly perceive that one of them was carrying an egg in its beak, while the other was crying "cuckoo, cuckoo." I know that there has been much dispute as to whether cuckoos do or do not carry their eggs; but in this instance I can personally testify that a cuckoo was carrying what was obviously an egg.

HONOR M. M. PERRYCOSTE.

Higher Shute Cottage, Polperro, Cornwall, June 14.

Jupiter's Satellites and the Velocity of Light.

I SHOULD be grateful to any readers of NATURE who can find time to send me two postcards, one *via* Siberia and the other *via* U.S. America, telling me what is the most trustworthy interval of time between the eclipses of Jupiter's first satellite (sidereal revolution 1d. 18h. 28m.) when the earth and that planet are in conjunction and in opposition. Watson, on p. 503 of "A Text-book of Physics," fourth edition, gives $T-T'=1992$ sec., and Everett, on p. 82 of "C.G.S. System of Units," gives as the best determination of the mean distance of the earth from the sun $1{\cdot}49465(10)^{13}$ cm. If these figures are to be trusted, Römer's method of determining the velocity of light ranks second to none, as it yields the figure $3{\cdot}0012(10)^{10}$ cm. per sec. A. W. WARRINGTON.

Chengtu Fu, W. China, March 3.

Arcs of Halos.

THE phenomenon described by Dr. Ellison (NATURE, June 14, p. 312) is clearly the upper contact arc of the 46° halo, and is not very uncommon, even in the absence of the halo itself.

The Meteorological Office "Observer's Handbook" states:—

"The arcs of upper contact appear with their convex sides turned towards the sun. . . . The colour effects are often brilliant, red being turned towards the sun, *i.e.* on the convex edge of the halo. The coloration of the arc of upper contact of the halo of 46° is frequently exceedingly brilliant."

Meteorological memories are proverbially short, and town-dwellers miss many optical phenomena too common in the country to excite comment.

WALTER W. BRYANT.

Royal Observatory, Greenwich, June 26.

HORSE-BREEDING AND HORSE-RACING.

THE history of the English racehorse is a chequered one. During the Wars of the Roses many studs were dispersed, but owing to the re-importation of horses from the Continent during the reign of Henry VIII. the thoroughbred breed was re-established. Later, owing to the importation of numerous Oriental and other alien stallions and mares, the English breed of racehorses was for years in the melting-pot. In 1649 the Royal Tutbury Stud was handed over to Parliament, but a few years later Cromwell, though himself an owner of racehorses, found it necessary "for political reasons" to stop racing. History has been repeating itself. A valuable stud has recently been handed over to the Government, and racing has once again been virtually suspended. Further, some people not unduly biased by the objectionable features of race-meetings are asking, "Is racing necessary to maintain the pre-eminence of the English racehorse?" while others, including Sir H. H. Johnston, want to know "whether the type of horse that is evolved from horse-racing is of any use nowadays?"

It is well to bear in mind that the racehorse industry is a large and important one, and that the large sums received for horses exported help to pay for the raw material required for our cotton and other factories. But there is a more cogent reason than the economic one for preserving the racehorse. Unless we intend to retire once more to the fool's paradise we found so comfortable up to August, 1914, it is essential that we not only preserve the thoroughbred, but also, by more scientific breeding, add greatly to its value for military and other purposes. Light as well as heavy horses have played an important part in the present war, and, notwithstanding mechanical traction, they may play a still more important part in future wars. Horses for military purposes should have the vigour, staying power, and tenacity of mules combined with the cross-country instincts of hunters. Such horses can be obtained only by cross-breeding. It would be difficult to create and maintain a breed of hunters, and still more difficult to create breeds of the old pack-horse type suitable for military purposes. This being the case, it will continue to be impossible to provide Army horses without the help of the thoroughbred. The modern English racehorse is said to be "more remarkable for speed than stamina"; nevertheless, crosses having a large infusion of thoroughbred blood have often as much staying power, intelligence, and courage as Arabs.

Hitherto, while Continental Powers have been spending annually large sums in breeding, or providing facilities for breeding, military horses, our Army Remount Department has looked to thoroughbred and other breeders to provide them with all the different types of service horses required, has, in fact, trusted to meet the demands of the Army by misfits obtained at a price which scarcely paid for their upbringing.

Many who realise the national importance of maintaining the English and Irish racehorses have some difficulty in realising that racehorse breeding implies racing. They admit that it is impossible to create and maintain herds of "1000-gallon cows" without keeping milk records, and that unless records are kept it is impossible to have strains of "200-egg hens," but they fail to appreciate the importance of having continuous records giving the performance of racehorses. It is impossible by looking at or handling a cow to say whether or not her offspring will prove as good milkers as her pedigree suggests, for everything depends on the contents of the germ-cells, and the only way to obtain information about the composition of the germ-cells is to test the milking powers of the offspring. When a thoroughbred stallion has a distinguished racing record there is a probability that he will prove a successful sire, but the only sure test is the performance of his offspring. As thoroughbreds are an unstable blend of several distinct types they rarely breed true, hence breeders in selecting stallions should be guided mainly by the racing records of their offspring. Sometimes indifferent performers acquire great distinction at the stud. "Stockwell" is said to have achieved at the stud "the most brilliant success of any sire of all time," and he is often referred to as the Emperor of Stallions. The sire of "Stockwell" ("The Baron") was the son of the very unattractive, fiddle-headed mare "Echidna," who was never saddled; "Stockwell's" dam ("Pocahontas") was a bad roarer and an indifferent performer on the Turf and deficient in quality, yet "Pocahontas," through "Stockwell," "Rataplan," "King Tom," and others who inherited her immense vitality, did much to increase the stamina of the modern English racehorse. But for the racing test the value of the "Pocahontas" and "Echidna" blood would never have been realised.

The necessity of testing the speed, endurance, etc., of possible sires was first realised about the beginning of the seventeenth century, but the importance of directing more attention to the performance of the offspring than to that of either sire or dam is not yet sufficiently recognised. During a considerable part of last century the practice of considering almost exclusively the records of the sire did little harm, because (as Osborne points out in his "Horse-breeders' Handbook") in former times one out of every three horses bred could win a race, but since the 'eighties it is doubtful if more than one in twenty of the horses bred has won a race. That a change has taken place since it became the fashion to have large sales of yearlings is supported by Sir Walter Gilbey, who, in 1898, pointed out that twenty-two yearlings, sold in 1895 for 46,200 guineas, only won three races in 1897 worth 1080*l*., and that twenty-two, sold for 34,850 guineas as yearlings in 1894, had failed, when their racing career was nearly over, to earn one-half of what they originally cost. Obviously, if only about 5 per cent. of the racehorses bred have the speed and endurance required to win a race, it is important that facilities should be provided for systematically testing young horses as soon as their training is sufficiently advanced. Breeding racehorses with-

out applying racing tests is bound to lead to deterioration. For this reason the continuance of such racing as may be required to test the value of the stallions and mares now at stud is essential. J. C. EWART.

THE DESTRUCTION OF HOUSE-SPARROWS.

THE question whether or not a particular species of wild bird is injurious or beneficial is one that is difficult to answer, but it is manifestly unfair to complicate the matter further by raising issues that are foreign to the subject, or by the publication of random statements which are not substantiated by actual facts.

Recently in the *Times* a correspondent recorded "a plague of caterpillars such as are taken by the sparrows to feed their young," and deplores the action of the Board of Agriculture in issuing an Order for the destruction of the house-sparrow. Unfortunately, the correspondent does not mention the species to which this caterpillar belongs; presumably it is the larva of the Winter Moth (*Cheimatobia brumata*, L.), upon which the house-sparrow feeds its young during the nestling period, but only to a limited extent. For years past we have had plagues of caterpillars when house-sparrows were free to breed and multiply, and careful inquiry has shown that such outbreaks are almost universally due to the omission of grease-banding of the fruit trees, or, in the case of other species, to the absence of the spraying machine. Owing to the present scarcity of labour, either of these reasons may account for the plague of caterpillars, so that the demand for "the immediate reversal of the orders given" by the Board of Agriculture is unjustifiable. In view of the above and similar statements now appearing in the Press, it may be well once more to state the economic position of the house-sparrow as related to agriculture and horticulture.

First, the writer would like to state that he is in full agreement with the action of the Board of Agriculture, believing from long experience and close study of the food and feeding habits of the house-sparrow that, as a result of its recommendation, great benefit will accrue to both the agriculturist and the horticulturist.

Gurney, who investigated the food of this species in 1885, stated that "fully 75 per cent. of an adult sparrow's food during its life is corn of some kind. In young sparrows not more than 40 per cent. is corn, while about 40 per cent. consists of caterpillars and 10 per cent. of small beetles. This is up to the age of sixteen days." This statement was founded upon an examination of 694 dissections. In 1910 the writer commenced to work upon this species, and by June, 1914, had examined 404 adults and 329 nestlings, obtained from fruit-growing, agricultural, and suburban districts. Since then the work has been continued, so that up to the present time upwards of 750 adults and 470 nestlings have been investigated, and the results clearly show:—

(i) That the house-sparrow is far too plentiful, and in agricultural and suburban districts it still requires very drastic reduction.

(ii) That, to a less extent, perhaps, it requires reducing in number in fruit-growing districts, and were this carefully carried out annually, after the nesting period, the good done during that season might probably compensate for the harm occasioned during the remainder of the year.

(iii) That in agricultural districts the food of 75 per cent. of the sparrows consists of corn.

(iv) That, apart from the nesting season, the house-sparrow does far more harm than good; indeed, its depredations on cereal crops alone entail a most serious loss to the farmer and the country in general.

As a result of the numbers of house-sparrows that are now, very wisely, being destroyed, we shall, in all probability, see a marked increase in the number of truly insectivorous birds, which are invaluable to the fruit-grower.

As to the continuance of the present Order, all must depend upon the number of birds destroyed in fruit-growing districts; but there is little fear, in the writer's opinion, of their extermination in agricultural or suburban districts, and there the Order might be wisely continued.

From the above recorded observations and those previously published, no unprejudiced mind will doubt the wisdom of a drastic reduction of this species. Enthusiasts and humanitarians may continue to write upon the value of this bird to the farmer, etc.; but the futility of such statements must be apparent to the most casual observer, unless they are supported by trustworthy and carefully obtained facts as to the precise nature and quantity of the food, while such investigations as have been conducted entirely fail to support the popular view that the insects destroyed during the nesting season compensate for the wide destruction occasioned by the species generally during the remainder of the year.

There is a very general, but entirely mistaken, opinion that the house-sparrow feeds largely upon insects. During the nesting season the food fed to the young birds, and in all probability most of that taken by the parents, consists mainly of insects, worms, and slugs; but during the remainder of the year it is mainly grain of some kind.

No thinking individual wishes or advocates the destruction of truly beneficial species of wild birds; on the contrary, every encouragement should be offered them, provided that they are not permitted to increase to such an extent that a change in their feeding habits is forced upon them by reason of their numbers.

Whilst the majority of species of wild birds are undoubtedly beneficial, no increase in their numbers will ever lead to the extermination of any of our common orchard pests. That they aid in the control of such pests is perfectly true, but so long as artificial conditions prevail—*i.e.* the association in a given area of a large number of trees of a particular species—so long will it be necessary to spray, grease-band, and carry out clean cultivation. If the house-sparrow is the

potent factor that some writers claim, then with the countless hordes that have devastated the country during the past ten or fifteen years there should be scarcely a caterpillar left; but, as I stated in 1913, this bird "has been allowed to increase to such an extent that it has become one of the worst pests we have," and "at present the attitude of all farmers must be one of extermination." Finally, I think we may leave the reputation of the Board of Agriculture to take care of itself, for it is a gross exaggeration, unsupported by facts, to say that "it is clear to every naturalist and observer that a great mistake has been made."

WALTER E. COLLINGE.

THE PUBLICATION OF THE "KEW BULLETIN."

We are glad to see that the order suspending the publication of the *Kew Bulletin*, to which reference was made in NATURE of May 24, is likely to be withdrawn. Replying to a question asked by Mr. Peto in the House of Commons on June 18, Sir R. Winfrey said: "The *Kew Bulletin* was suspended by the Stationery Office in consultation with the Board of Agriculture and Fisheries. The whole matter is, however, at present under reconsideration, and I hope it will be found possible to arrange for the continuation of the publication."

After the appearance of the article in NATURE deploring the action of the Controller of H.M. Stationery Office in suspending the publication of the *Kew Bulletin*, the subject was taken up by the *Times*, which, in an article entitled "False Economy," also regretted the Controller's decision. The British Science Guild took prompt steps to direct attention to the matter; and in the House of Commons on June 11 Sir William Phipson Beale, a member of the Executive Committee, asked the Secretary to the Treasury

on whose advice the decision of the Controller of H.M. Stationery Office was taken to suspend the printing and publication of the *Kew Bulletin*; whether his attention was called to the importance of that publication for the spread of valuable information throughout the Empire relating to plant culture and the supply of fibre, timber, and plant products; if he can give the names of any experts concerned in the scientific and commercial development of Colonial industries connected with plant culture who were consulted in the matter; whether the editor was consulted; and whether any estimate was made of the consumption of paper involved in the continuance of the *Kew Bulletin* as compared with the consumption of paper for dramatic, sporting, pictorial, and other fashionable papers which have no practical value for the development of the resources of the Empire either during or after the war.

The reply given by Mr. Stanley Baldwin was as follows:—

In reply to the first part of the hon. member's question, it is understood that the Secretary of the Board of Agriculture and the chairman of the Select Committee on Publications were consulted by the Controller of the Stationery Office prior to the suspension of the *Bulletin*; and that the Controller's decision was acquiesced in by the Director of the Royal Botanic Gardens. The editor of the paper was, I am informed, consulted by the Controller before any action was taken. The answer to the second part of the question is in the affirmative, and that to the third part in the negative. The consumption of paper for dramatic, sporting, pictorial, and other fashionable papers is not within the jurisdiction of the Controller of the Stationery Office.

It will be noticed that this reply does not cover the points raised by Sir William Beale, and we believe that Mr. Baldwin was not in the possession of the full facts when he suggested that suspension was decided upon after consultation with suitable advisers and with the consent of the Director of the Royal Botanic Gardens, who is the editor of the *Bulletin*. We are confident that everyone who is competent to pass a judgment upon the case would express the opinion that the discontinuance of the *Kew Bulletin* upon the ground that it was "not essential" could not be justified for a moment. The subjoined memorandum, signed by members of the Executive Committee of the British Science Guild and sent to the Secretary of the Treasury on June 9, affords in itself sufficient reason for the continuance of the publication of the *Bulletin*, which Sir R. Winfrey hopes will be possible. If that end is attained, the Guild is to be congratulated upon the part it has played in bringing about the abrogation of an unfortunate and ill-considered decision.

The British Science Guild learns with much astonishment that the Controller, H.M. Stationery Office, has decided that the *Kew Bulletin of Miscellaneous Information* is not essential, and has therefore suspended its publication until more normal times are reached. The Guild is strongly of opinion that such action should not have been taken without referring the question of the value of the *Bulletin* to competent scientific authorities; and it protests against the suspension of publication at a time when every effort should be made to promote the development of the plant resources of the Empire. The part which Kew has played in the collection and distribution of cinchona, india-rubber, and many other plant products, including timbers, should have preserved the *Bulletin* from any restriction on account of the great benefits it has been the means of conferring, not only upon the Empire, but also upon humanity at large.

The *Kew Bulletin* was first issued in January, 1887, in response to the demand for the prompt publication for general use of any information likely to be of service to those engaged in science, cultivation, or commerce connected with the plant and agricultural resources of the Overseas Dominions. The prefatory note to the first number says:—

"It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire, they may also be of service to members of the general public interested in planting or agricultural business in India and the Colonies."

The *Bulletin* was started at the desire of Parliament, upon the recommendation of the First Commissioner of H.M. Works and Public Buildings (Mr. Plunket). It has been the vehicle for the publication of a vast amount of information of various kinds, some on purely scientific, but mostly on economic, subjects. The "miscellaneous information" supplied by the *Bulletin* has ever been welcome to botanists and to those concerned with the utilisation of vegetable products; and it has provided a valuable record of Kew work in all its varying aspects.

The *Bulletin* is sent out to all botanic and agricultural departments in correspondence with Kew, and much of its contents is usually reprinted in local journals. It affords the best evidence of the many activities of the Royal Gardens, in advising upon the possible development of the natural resources of our Colonies and Dependencies. Almost every issue contains a number of plain statements of attempts made to introduce new and commercially profitable plants in suitable districts, of improved methods of cultivation, and of work that men trained at Kew are doing in the various parts of the world to which they have gone from the Royal Gardens. By suspending the publication of the *Bulletin*, the link connecting Kew with the whole of the botanic stations of the Empire is broken, and the means of communicating information to them all is removed at a time when the information afforded is no less valuable than in pre-war periods.

Without knowledge of the functions fulfilled by the *Bulletin*, and an intimate acquaintance with what it has accomplished in providing information not accessible in any other form in regard to the capabilities of the various parts of the Empire for the cultivation of plants of economic importance, no Government official is capable of deciding justly whether the *Bulletin* is an essential publication or not. The British Science Guild urges, therefore, in the interests of Imperial development, that the decision be submitted to a competent tribunal, which will take into consideration, not only the shortage of paper, but also the value of what is printed upon it. It is confident that the result of such an inquiry would be a judgment in favour of the continued publication of the *Bulletin*.

SYDENHAM (President, British Science Guild).
NORMAN LOCKYER (Chairman of Committees).
BOVERTON REDWOOD (Deputy-Chairman, Executive Committee).
WM. P. BEALE, W. MATHER (Vice-Presidents).
HUGH BELL (Vice-Chairman of Committees).
JOHN COCKBURN.
AVEBURY (Hon. Treasurer).
ALEX. PEDLER (Hon. Secretary).
W. H. COWAN, R. A. GREGORY, A. LIVERSIDGE, W. A. J. O'MEARA, F. MOLLWO PERKIN, JOHN PERRY, RONALD ROSS, A. A. C. SWINTON, SARAH J. D. SHAW, CARMICHAEL THOMAS, R. MULLINEUX WALMSLEY, HOWARD S. WILLSON, J. S. YOUNG (Other members of the Executive Committee).

PROF. KR. BIRKELAND.

WE regret to learn from the *Morning Post* that Prof. Kr. Birkeland, of Christiania, died in Tokyo on June 18. He was one of the few speculative physicists of the day the value of whose work would be generally admitted in commercial circles. He was the co-inventor with Mr. Sam Eyde of the Birkeland-Eyde direct process for the manufacture of calcium nitrate by the extraction of nitrogen from the atmosphere. In the Journal of the Royal Society of Arts, May, 1912, Mr. E. Kilburn Scott records how, starting with a 25-h.p. experimental plant in 1903, the company controlling the Birkeland-Eyde patents had 200,000 h.p. at work in 1912, and was likely to add a further 300,000 h.p. before the end of 1916. This was by no means the only successful patent in which Prof. Birkeland was interested.

As a theorist Prof. Birkeland was extraordinarily bold in his speculations. He had theories on the internal constitution of the sun and the nature of sunspots, on the sun as a magnet and as a source of electricity, on the origin of the planets and their satellites, on the nature of various celestial phenomena, especially the zodiacal light, on the production of aurora and magnetic storms, and on the past geological history of the earth. The wealth acquired by his practical gifts enabled Prof. Birkeland to experiment and arrange for solar and magnetic observations on a large scale. He made many striking experiments with an artificially magnetised terella in a high vacuum, directing towards it electrical discharges, intended to represent the discharge of corpuscles from the sun. In some of his experiments the vacuum chamber had a capacity of 70 litres, and the supply of electrical energy required a 6-h.p. engine. He obtained phenomena closely resembling various forms of aurora, which he believed to represent the conditions under which magnetic storms appear on the earth.

Prof. Birkeland was largely responsible for the institution of special magnetic observatories in Arctic regions in 1900, in 1902-3, and again during the last few years. His two large volumes in English, "The Norwegian Aurora Polaris Expedition, 1902-3," besides much speculation as to the causes of magnetic storms, contain much important information as to the simultaneous progress of magnetic disturbance at different parts of the earth. Since 1910 he had lived a good deal abroad for observational purposes, and numerous communications to the *Comptes rendus* of the French Academy of Sciences describe his various conclusions and speculations. In one dated July, 1914, he expressed his intention of devoting the next three years to the study of the zodiacal light in Natal, at Helwan, and in Uganda, and he was working in Egypt in 1915 and 1916. Presumably the continuation of his quest had taken him to the Far East. At the time of his death Prof. Birkeland was only about fifty years of age; but when last in England, in 1913, he had aged considerably in appearance and become very deaf. He was, however, as animated as ever when discussing his theories.

C. CHREE.

NOTES.

ON June 20 Lord Montagu of Beaulieu gave an interesting lecture before the Aeronautical Society of Great Britain on the world's air routes and their regulation. He pointed out how favourably placed the British Empire was in this matter, inasmuch as its many possessions were so scattered about the globe that suitable landing and halting places could be provided without the necessity of asking for concessions from other nations. Lord Montagu based his calculations upon an assumed speed of 120 miles an hour,

and showed that with two five-hour periods per day the journey to India could be accomplished in four days. Under the stage which aeroplanes have now reached, the carriage of mails and passengers to India seems quite a feasible proposition; the meteorological conditions along the tracks that might be followed, except at the British end in the winter, are quite good. Crossing the Atlantic is another matter, especially from Europe to America; the shortest track, from Ireland to Newfoundland, is in the winter a region of gales, mostly from some westerly point, and if the more favourable weather that prevails further south is sought, the distance is about doubled. Lord Montagu's suggestion is that certain levels should be assigned to certain types of traffic, but it has been estimated that at any given time one-half of the earth is covered with clouds, and a pilot above a sheet of clouds cannot keep his course, as there is nothing to tell him the strength and direction of the air drift to which he is exposed. It follows therefore that a pilot aiming at a definite place must fly low enough to see the earth at frequent intervals; in or above a cloud sheet he would have no horizon and could not rely on astronomical observations for his position. Thus the traffic to which the highest levels were assigned would be at a great disadvantage.

THE Executive Committee of the Conjoint Board of Scientific Societies presented its report on the work of the last six months at the fourth meeting of the Board, held at the Royal Society on June 13, Sir Joseph J. Thomson in the chair. The report indicates that a number of important questions of scientific and industrial importance has occupied the attention of the Board. Various bodies are at present interested in the formation of a census of the mineral resources of the Empire. It was agreed to enter into communication with these bodies and to make suggestions with a view to the publication of information in a form useful to the general community. Interim reports were received and approved on the necessity for an anthropological survey of the British people, on the best methods for carrying on the International Catalogue of Scientific Literature, and on an inquiry into the desirability or otherwise of the adoption of the metric system throughout the British Isles. The sub-committee on National Instruction in Technical Optics reported that a scheme approved by the Board of Education had now come into operation (see NATURE of May 24 and June 14). A sub-committee, having considered special cases of magnetic disturbances revealed by a magnetic survey of the British Isles, and their possible connection with the occurrence of iron ores, recommended a detailed investigation of two test areas, in order to ascertain how far, under the conditions of the British iron ores, the magnetic survey was likely to prove of economic value. Arrangements for carrying out the investigation are in progress. An agricultural sub-committee, with the Earl of Portsmouth as chairman, reported that it is at present devoting itself mainly to engineering questions. It is engaged in collecting information with regard to the transport of raw materials to farms and agricultural products from them, to the power required for this purpose, and for seasonal operations on the land, with the view of comparing the relative advantages and costs of steam or internal-combustion engines and electrically operated machines. A sub-committee was appointed to report on what is at present being done to ascertain the amount and distribution of water power in the British Empire. A complete report of the first year's work of the Board will be published in due course.

WE notice with regret the announcement of the death on June 19 of Dr. Robert Bell, F.R.S., formerly chief geologist of the Geological Survey of Canada.

THE King has been pleased to award the Edward Medal of the First Class to the representatives of Mr. Andrea Angel and Mr. George Wenborne, who lost their lives in endeavouring to save the lives of others on the occasion of a fire which broke out at the Silvertown Chemical Works on January 19 last.

IN order to celebrate the centenary of the birth of Henry D. Thoreau, the Humanitarian League (53 Chancery Lane, W.C.2) has arranged a meeting to be held in the Caxton Hall, Westminster, on the evening of July 12. The chair will be taken at 8 p.m. by Sir John L. Otter, J.P., and short addresses will be given by various speakers. Admirers of Thoreau's writings are invited to be present.

IN a recent issue (June 14, p. 312) we directed attention to a report that the Prime Minister and others were awakened by the sound of the explosions at Messines on June 7. The evidence in favour of the sound having been heard in and near London is, however, insufficient, and information since received from Flanders throws doubt on the statement. An officer of the Royal Engineers, who was only a mile from the largest mine when it was fired, describes the noise as "not so very great"; while another, who was at a distance of eight miles, saw the flash, waited for the noise, and heard only a slight "phit." A contrary wind might, of course, have tilted the sound-waves over the latter observer, but the wind seems to have come from the direction of the front, for the air at the time on the west side was charged with lachrymatory gases. Moreover, a well-prepared explosion is seldom noisy.

THE governors of the West of Scotland Agricultural College have recently issued, in the form of a bulletin (No. 81), a summary by Principal W. G. R. Paterson of certain schemes for the training and employment, particularly in rural occupations, of discharged disabled sailors and soldiers. The three schemes dealt with were selected from eight submitted in response to an offer of prizes placed at the disposal of the governors through the generosity of an anonymous donor. Each scheme is outlined and critically discussed by Mr. Paterson, who contributes also a comprehensive memorandum drafted independently for the consideration of the governors of the college. It is not possible within the compass of a short note to indicate adequately even the essential features of the different schemes, and it must suffice to commend their suggestiveness as to the useful part that may be played in the solution of the problem by the regeneration of our villages, the establishing of colonies of smallholders, the setting up of isolated holdings, and the revival of a number of subsidiary rural industries, as well as the development of new industries.

La Nature (No. 2279, June 2, 1917) devotes a special article to the question of the method of choosing an employé. It is a plea for a more scientific treatment of the problem of adjusting the work to the worker, so that the right person is put to the work for which he is naturally adapted, and also that the work itself should be analysed, with the object of discovering what particular qualities, both mental and physical, it will demand, and, having discovered these, to train the worker along those lines. The writer quotes with approval the attempts made in America in the direction of scientific management of labour. He describes various tests, such as tests of manual

dexterity, of comprehension, of judgment, etc., which he suggests might be advantageously used by employers of labour when selecting workmen. It is, however, necessary to issue a warning to those enthusiasts who are tempted to accept "tests" uncritically, viz. that one is not entitled to assume that, because a person does well in any given test, he will necessarily be willing to do well in work demanding that same quality for an employer. That he *can* do it is not equivalent to that he *will* do it. Again, it is necessary to be on one's guard against believing in some one test as a test of a particular capacity. It is possible to have, *e.g.*, an excellent memory in a given line of interest, and a very weak one in some other direction. The article is interesting and timely, but much yet remains to be done by trained scientific workers before the method of tests can be generally applied.

WE have received a copy of a pamphlet published by the justice to the Mountain Committee in Tacoma, Washington, and containing the appeal submitted to the United States Geographic Board urging that the mountain now officially known as Mount Rainier should in future be called Mount Tacoma. The request is supported by the House of Representatives of the State of Washington, the Federation of North-West American Indians, and public opinion generally in Seattle and Tacoma. The mountain, which lies about fifty miles east of Puget Sound, in the Cascade range, was discovered in 1792 by Vancouver, and named by him after Rear-Admiral Rainier, R.N. Rainier had certainly no connection with that coast, but the arguments adduced against the use of his name for the mountain do not seem to us to be very convincing. On the other hand, a great deal is to be said for the use of the name Tacoma, which is the modern version of the old Indian name, and the one by which the mountain is generally known in the district. And, after all, the local residents must be the arbiters in the matter, and no decision of the United States Geographic Board can alter local usage. The committee has gone to a great deal of trouble in collecting evidence as to written and oral usage, and has made out a good case for the use of Tacoma in preference to Rainier.

WE have received the report of the bacteriologist (Mr. Ward Giltner) of the Agricultural Experiment Station, East Lansing, Mich., U.S.A., for the year ending June 30, 1916. Much research has been carried out on contagious abortion of the cow. Attempts have been made to render animals insusceptible to infection with this disease, which is caused by *Bacillus abortus*, by vaccination with living and dead cultures, but with little success. Details are also given of the routine work carried out at the station.

THE number of cases of paralysis following gunshot injury of nerves in the present war has given prominence to the subject of electrical testing of nerve and muscle, and the value to be attached to results of such testing for diagnosis and prognosis. The methods of testing commonly applied are by means of condenser discharges or by the faradic or the galvanic current, but it is doubtful if the reactions of the *muscles* induced thereby give information of the state of the nerve supplying them when once reaction of degeneration has developed. In a paper in the *Archives of Radiology and Electrotherapy* for May (No. 202) Dr. Adrian has applied to the human subject a method that was employed by Keith Lucas at Cambridge. A galvanic current of known and variable strength and duration is used. Dr. Adrian makes use of a time-constant known as the *chronaxie*. It is remarkably constant for muscle with undamaged nerve, and has a short duration; for denervated muscle it is very much longer. The method promises to be a useful one.

THE *Geographical Journal* for May (vol. xlix., No. 5) includes a singularly interesting paper by Mrs. Scoresby Routledge describing the results of the expedition to Easter Island under the leadership of her husband and herself. We probably now possess all the information which local investigation can secure about the strange buildings and statues which have so long been a problem for anthropologists. The reading of this suggestive paper at a recent meeting of the Royal Geographical Society was followed by a discussion in which Sir Hercules Read, Sir H. Howorth, and Messrs. T. A. Joyce, A. P. Maudslay, Basil Thomson, and Henry Balfour took part. A most interesting suggestion was made by Mr. Joyce that on the basis of skull measurements the earlier Easter Island natives displayed Melanesian affinities. Mr. Balfour added that for affinities with their culture we must look rather to the West than to the East, the New World influence being practically ruled out. In his opinion the statues appear to show a relation to Melanesian art. This is the latest phase of this long-protracted controversy, and though the results are still to some extent uncertain, the problem has now decidedly advanced towards a definite solution.

THE Proceedings of the Yorkshire Geological Society, new series, vol. xix., part iii., March, 1917 (Hull: A. Brown and Sons, Ltd.; price 7*s*. 6*d*. net) is devoted to a paper by Mr. T. Sheppard, entitled "William Smith: His Maps and Memoirs." No serious student of geology can fail to be interested in the life of William Smith, whose stupendous labours laid a sure foundation for the science of stratigraphy. Several memoirs of his life and work are in existence, and Mr. Sheppard has now said what may be presumed will be the last word on this subject. The paper is naturally concerned with Smith's work in Yorkshire as lecturer and geological explorer, but much space is given to full details of the publication of his maps, sections, and memoirs, and this information will be of great value to librarians and others. Reference is also made to the efforts of earlier writers to understand and explain geological features, and in this connection the ideas of George Owen, Martin Lister, John Strachey, John Woodward, Nicolas Desmarest, Christopher Packe, John Michel, John Whitehurst, John Smeaton, Prof. Jamieson, and James Parkinson have been briefly summarised. The paper is illustrated by numerous plates and figures in the text, and concludes with a bibliography.

MESSRS. RICARD AND BARRAL have recently communicated to the Société Médico-Chirurgicale Militaire de la XIVe Région a very simple method of ascertaining rapidly and easily whether water has been poisoned. It consists in placing a few fish—blay, gudgeon, etc.—in a jar filled with the water to be tested. Two drops of nicotine per litre kill the fish in less than a minute; two drops of conicine paralyse them in six minutes and kill them in eight; one decigram of solanine kills in one and a half hours, the same quantity of cocaine in one hour, and the same quantity of stovaine in ten minutes. One milligram of aconite kills in three and a half hours; twenty drops of aniline in one and three-quarter hours; seven milligrams of digitalin only take effect in four hours. Veratrine does not appear to have any effect; one decigram of potassium cyanide kills the fish in two minutes; two decigrams of corrosive sublimate in ten to twelve minutes; two grams of lead acetate in five hours; five grams of zinc sulphate in two hours; two grams of copper sulphate in forty-five minutes; and thirty-five centi-

grams of picric acid in five hours. On the other hand, the fish do not appear to be inconvenienced by morphine, cantharidine, atropine, pilocarpine, hyoscyamine, scopolamine, or arsenical salts. Water in which fish die in less than four hours should therefore be considered as dangerous.

THE Journal of the East Africa and Uganda Natural History Society (vol. vi., No. 11) contains a number of extremely interesting papers. Not the least of these is that by Mr. R. L. Harger on the desiccation of Africa. Reviewing the records on this theme of pioneers like Livingstone, Harris, and Selous, the author adds much valuable matter of his own, covering a vast extent of country from Tanganyika southward and westward. That the diminution of the chain of the great lakes and the river systems feeding them is proceeding at a most disconcerting rate there can be no question, but the author makes no suggestion as to the causes to which this shrinkage is due. Natural history notes from British East Africa, by Mr. A. Loveridge, afford one a vivid insight into the wealth and variety of the fauna of this part of Africa, for the habits and haunts of many of the smaller creatures unnoticed by the big-game hunter are vivaciously described.

OWING to the war the completion of the reports on the collections of zoological and botanical specimens obtained by the ill-fated British Antarctic (*Terra Nova*) Expedition, 1910, has been seriously delayed. Some of them we have already noticed in these columns. The trustees of the British Museum have now issued Dr. W. T. Calman's report on the Crustacea, and two reports on the marine and fresh-water Algæ, and these sustain the high standard of their predecessors. Four very diverse groups of Crustacea are represented in this collection, and of these two only, belonging respectively to the Cumacea and the Phyllocardia, were taken in Antarctic waters. Two species of Cumacea new to science were taken off the extreme north of New Zealand, and one new species of Stomatopod was taken off the Brazilian coast. Of these Dr. Calman gives admirable descriptions and some very beautiful figures. The marine Algæ have been worked out by Mr. and Mrs. Antony Gepp, and the Melobesieæ by Mme. Paul Lemoine. Only two species of marine Algæ were taken in Antarctic waters, and these are not new. The only specimens of Melobesieæ collected proved, on examination, to represent two species new to science: one of these was taken off New Zealand, the other off Trinidad. Very beautiful figures of both are given. All the fresh-water Algæ collected were Antarctic. They were entrusted to Prof. F. E. Fritsch for investigation, and proved to contain two new species. From the material collected Prof. Fritsch has been enabled to describe the cell-division of *Pleurococcus antarcticus*, which was hitherto unknown.

THE annual report for 1916 of the Horticulture Branch of the Board of Agriculture and Fisheries contains, amongst other matters of interest, a summary of the work accomplished in connection with the investigation and control of various plant diseases and insect pests. Of the notifiable diseases a distinct improvement is recorded in the case of American gooseberry mildew, but a much less satisfactory position with regard to wart disease of potatoes. The latter disease has not only spread throughout areas known previously to be infected, but has also made a sporadic appearance in several new places. Glamorgan, South Lancashire, and Durham are mentioned as areas in which the disease is very prevalent. It is gratifying to note, however, that in areas previously notified as infected very satisfactory results have been obtained by the action of the Board in securing the use of resistant varieties. It is reported that the long and elaborate inquiry into the parasitism of the large larch sawfly has been concluded, but the results have not yet been tabulated. With reference to plant diseases not caused by scheduled pests, special mention is made of the "capsid bug" disease of apples and apple mildew, both of which have been the subject of investigation by the officers of the branch. An interesting summary is also given of the present position with regard to Isle of Wight bee disease, the supervision of which is included among the duties of the branch. The report this year is not issued separately, but appears in the form of an article in the *Journal of the Board of Agriculture* for May.

MEMOIR 92 of the Canadian Geological Survey, by Mr. J. A. Dresser, indicates the excellent prospects of water-power in the Lake St. John district, north of the city of Quebec, and includes an opportune review, by Prof. A. Stansfield, of the smelting of iron-ores rich in titanium. This article, with its references to recent work, will be of service in mineral development elsewhere, and possibly in Ireland.

THE Bulletin of the Hawaiian Volcano Observatory for January, 1917, is of more than usual interest from its record of experiments with Seeger cones enclosed in iron pipes some 40 ft. long, which were thrust into grottoes of glowing lava. It is shown that in a distance of 20 ft. the temperature may vary from 850° C. to 1150° C., and there is some indication that the incandescent upper layers of the lava, emitting gases, may be of higher temperature than the more viscous mass below.

MR. J. C. H. MINGAYE describes several meteorites in the Records of the Geological Survey of New South Wales, vol. ix., part iii., 1916. The Government printer may be congratulated on the beautiful coloured plate showing the various types of olivine in the pallasite of Molong. Mr. Mingaye's detailed analyses of two australites (obsidianites) in the same part serve to emphasise the difference between these bodies and ordinary meteorites.

PROF. C. SCHUCHERT, in discussing the correlation of strata on the basis of palæogeography (Bull. Geol. Soc. America, vol. xxvii., p. 491, 1916), provides an interesting series of maps showing the prevalent conditions in the west of North America during successive Mesozoic periods, and a still more valuable conception of the relations of land and water in early Permian time, in the form of a map of the world, on which the areas are marked where evidences of Permo-Carboniferous glaciation have been found. Teachers of geology may like to enlarge this map into a diagram. The author supports the theory of the permanence of oceanic and continental areas, which seems to many geologists to be based partly on our ignorance of what underlies the oceans, and partly on the definition of oceanic water.

IN the Transactions of the Royal Society of South Africa (vol. vi., part i.) Mr. S. H. Haughton, assistant director, South African Museum, describes ancient human remains found during the excavation of a drain at Kolonies Plaats, Boskop, in the Potchefstroom district of the Transvaal, in 1913. The remains found consist of a large portion of a calvaria, the horizontal part of the left ramus of the mandible, the major portion of a temporal bone, and some fragmentary limb-bones. The distinctive feature of the

skull is that at the level of the posterior part of the parietal there is a decided flattening, which continues on to the superior part of the occipital bone. The occipital projects strongly, and has a thick ridge bifurcating downwards. The flattening of the skull is not paralleled by any skull in the South African Museum, although, according to Mr. Boule, it has been seen on some negro skulls and also upon a Namaqua skull now in the Paris Museum. The paper gives a full account, with photographs, of this interesting specimen. Prof. G. Elliot Smith thus sums up the question: "Whatever the date of the Boskop remains may be, the evidence now in our possession suggests that this early inhabitant of the Transvaal represents the type of the immediate ancestors of the men of the Upper Palæolithic (or, as I prefer to call it, the Neanthropic) age, possibly somewhat modified in the course of his southern migration. It probably represents the earliest (not necessarily in actual age) known phase of *Homo sapiens* in the course of his transformation from a condition analogous to that of Neanderthal man to that of Cro-Magnon."

Two very important palæontological papers by Mr. R. Bullen Newton have recently been published. The first, "On the Conchological Features of the Lenham Sandstones of Kent and their Stratigraphical Importance," forms the subject of his presidential address to the Conchological Society of Great Britain and Ireland (Journ. Conch. Soc., vol. xv., pp. 56–149, four plates). The work on these puzzling deposits begun by Prestwich, Wood, Lyell, and other noted geologists, was well advanced by the late Mr. Clement Reid (NATURE, vol. xxxiv., 1886, pp. 341–43, and in his "Pliocene Deposits of Britain," Mem. Geol. Surv., 1890), who regarded the beds as of Coralline Crag age, and equivalent to the Diestian of Belgium. Mr. Newton has now very carefully gone over Mr. Reid's material in the Museum of Practical Geology with the Graham Wallas and other collections in the British Museum (Natural History), and here discusses most fully each fossil species and its occurrence in time and space, illustrating photographically all the more important forms. The conclusions he comes to will certainly surprise our older geologists, for he terminates the Pliocene with the Red Crag, and refers to the Upper Miocene, in descending order, (*a*) the Coralline Crag; (*b*) the Diestian of Belgium; (*c*) St. Erth beds; (*d*) Lenham Sandstones; (*e*) Anversian of Belgium; and (*f*) the Upper Miocene of Germany; whilst he refers the "Box Stones" to the Middle Miocene. These important and seemingly well-based conclusions deserve a wider notoriety than the pages in which they appear are likely to obtain for them. The second paper describes an interesting mass of "Fossiliferous Limestone from the North Sea" (Quart. Journ. Geol. Soc., vol. lxxii., 1917, pp. 7–22, one plate). After a painstaking investigation of its fossil contents, Mr. Newton decides that it represents a submarine exposure of beds belonging to the lower portion of the Coralline Crag. The accompanying plate is worthy of attention, since the process adopted is the best yet employed in this country for depicting shells.

Science for May 18 contains an address by Prof. R. D. Carmichael on the provision made by mathematics for the needs of science. While very properly defending the study of mathematics for its own sake, he points out that many of its most interesting problems have been suggested by natural phenomena, while, conversely, this debt has been amply repaid by the application of mathematics to astronomy, physics, and chemistry, not to mention other sciences. Prof. Carmichael is one of a group who are now working at a new development of the theory of difference equations, and he expresses a hope that this may have some direct application to theoretical physics. As he says, our latest physical hypotheses seem to be tending towards an atomic, discrete, or statistical form, so that differential equations are not always the most appropriate tools to be employed. Not impossibly we may have a Boscovitchian interlude, after which a deeper insight may bring us back to a flux-theory again. In any case, it is satisfactory to find that mathematics is still growing with remarkable vigour, and providing new methods of attacking a new set of problems.

A RECENT technological publication (No. 82) of the Bureau of Standards, Washington, describes an experimental investigation recently made of the causes of failure of a number of articles, particularly bolts, of wrought brass of the type 60 copper, 40 zinc, with special reference to the presence of initial stress. The work was taken up in connection with tests, made for the New York Board of Water Supply, of failed brass bolts which had been in service in the construction of the new Catskill Aqueduct, which is to supply water to the city from the watersheds of the Catskill Mountains. In view of the fact that most of the equipment and materials used in this construction would be subjected to the corroding action of both water and the atmosphere, a substitute was sought for steel, which would ordinarily be used, and it was considered possible to find a brass which would have mechanical properties comparable with those of steel and yet be practically incorrodible. As such a substitute the so-called manganese bronze was chosen. In the course of the investigation the physical properties, micro-structure, and initial stress distribution have been studied in failed and sound materials, not only from the Catskill Aqueduct construction, but also from the filtration plant of the city of Minneapolis, the Navy Department, and the Panama Canal, and in new material from a number of manufacturers. Failure has occurred (1) as a result of faulty practice in forging bolt-heads, flanging plates, etc.; (2) as a result of the presence of initial stress; and (3) as a result of service overstress due to drawing up bolts too tightly. This investigation shows that an average initial stress of 5000 lb./sq. in. (350 kg./cm.^{2}) is to be regarded as a safe limit for rods and bolts of this type of material under ordinary service conditions, in which the service load itself is not greater than from 5000 to 10,000 lb./sq. in. Experiments have also been made to ascertain under what conditions of annealing initial stresses could best be removed, and have shown that temperatures of from 300° to 400° C. are sufficient to reduce in from one to seven hours the initial stresses to a safe value.

MESSRS. ROSS, LTD., have purchased from the Controller appointed by the Board of Trade the Zeiss Optical Works at Mill Hill, including all machinery and tools therein; also their business premises at 13 and 14 Great Castle Street, W.1., including the stock-in-trade, etc.

OUR ASTRONOMICAL COLUMN.

ORBIT OF COMET 1915*a* (MELLISH).—The orbit of this comet, which was discovered by Mellish on February 10, 1915, and afterwards became a naked-eye object, has been investigated by L. Rosenbaum (*Ast. Iaktt. Stockholms Obs.*, vol. x., No. 5). The comet traversed a heliocentric arc of 205° during the eleven months of its visibility. After taking account of per-

turbations, the following hyperbolic elements were derived:—

Osculation 1915 *February* 10·0.

$$\begin{aligned} T &= 1915 \text{ July } 17{\cdot}18869 \pm 0{\cdot}00159 \text{ Berlin M.T.} \\ \omega &= 247^\circ\ 46'\ 5{\cdot}6'' \pm 3{\cdot}41'' \\ \Omega &= 72^\circ\ 16'\ 24{\cdot}1'' \pm 3{\cdot}66'' \\ i &= 54^\circ\ 27'\ 22{\cdot}1'' \pm 5{\cdot}11'' \\ q &= 1{\cdot}005338 \pm 0{\cdot}000006 \\ e &= 1{\cdot}000235 \pm 0{\cdot}000061 \end{aligned}$$

The residual errors are probably to be attributed to the division of the nucleus into two parts, which was observed about two months before perihelion passage, and before it can be considered certain that the true orbit was hyperbolic it will be necessary to discuss separately the observations before and after the change in the nucleus.

THE SOLAR PHYSICS OBSERVATORY.—The activities of the Solar Physics Observatory, Cambridge, appear to have been seriously curtailed through the absence of members of the staff on war service. From the fourth annual report, recently issued by the director, we gather that apart from some unfruitful attempts to photograph the spectrum of Venus with high dispersion, no observations other than those made with the spectroheliograph were undertaken. The sun's disc was photographed in calcium light on 117 days, and prominences at the limb on 104 days. These provide records for sixteen out of the thirty-seven days for which there were gaps in the Kodaikanal series, and the combined results account for 345 days during the year 1916. Laboratory experiments on the spectra of carbon and its compounds were continued, and further investigations of atmospheric electricity were carried on by Mr. C. T. R. Wilson.

THE SPECTRA OF NEBULÆ.—Some interesting results which have recently been obtained at the Lick Observatory with a new quartz spectrograph are described by Dr. W. H. Wright in Lick Observatory Bulletin No. 291. The optical parts are two 60° quartz prisms of the Cornu type, with lenses of about 11 in. focal length and 2 in. effective aperture. The instrument can be used either with or without slit, the collimator in the latter case being replaced by a concave lens of equivalent focal length, and the whole instrument so adjusted with respect to the mirror of the Crossley reflector that parallel light falls on the prisms. It has been very successfully employed as a slitless spectrograph in a study of the distribution in planetary nebulæ of the various radiations which make up their spectra, an image of the nebula being produced by each line of the spectrum. The monochromatic images thus obtained have been found to exhibit a great variety of forms for the same object. If there be a nucleus, it is usually represented by a streak of continuous spectrum threading the centres, giving the appearance of beads on a string. A number of strong nebular lines which have previously escaped notice have been detected in these photographs, among them being 3313, 3342, and 3444 A. Another interesting fact brought to light is that most of the planetary nebulæ show a faint continuous spectrum which begins abruptly at about 3652 A, near the termination of the hydrogen series, and extends with great uniformity far into the ultra-violet. A similar appearance has been noted in the spectra of solar prominences, and a corresponding absorption effect has been observed in the spectra of such stars as Vega and Sirius. There is reason to suppose that the continuous spectrum in question is associated with the Balmer hydrogen series, and that its production is in some way involved in the mechanics of line series radiation. Further laboratory investigations in this connection are suggested.

ANNUAL CONGRESS OF THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

THE union held its annual congress at the Linnean Society's rooms in Burlington House on June 6–9, which was well attended by delegates from all parts of the union's area. This was the first occasion of its meeting in central London, and was an undoubted success. The address by the president, Dr. W. Martin, dealt with "Science and the Industries," and traced the lines on which, by halting steps, the Government had in the past encouraged the study of science. It called on the nation to insist that its leaders shall give due recognition to the truth that the country's future is bound up with giving the fullest encouragement to workers in all branches of science, and urged the union to take its place as an organisation of value and power in the strenuous times before the country when the war is over.

Amid the upheavals to which industries have been subjected during the beating of ploughshares and pruning-hooks into implements of war, it may be that the country has already proceeded apace towards greater triumphs. Old machinery has been scrapped, antiquated custom flung away, and resources have been adapted to the stern demands of a people under arms. With new measures, new men have arisen. Unity, organisation, co-ordination, and precision are the weapons with which without misgiving the future may be faced. May we not fitly anticipate the time when from the ashes of an otiose past and an age of neglect a rejuvenated nation will have arisen among whom lethargy and indifference shall be as aliens? At such a time we shall regard the period before the shock of war was upon us as the ultimate remnant of the Dark Ages, and shall fail to understand that mental attitude which considered science a luxury and its application to the industries in need of advocacy.

Dr. A. Smith Woodward, in addition to lecturing on the mammalian remains which have from time to time been found in superficial deposits of London, showed members the human remains which were dug up at Piltdown by the late Mr. Dawson and himself, including the recently found fragments which have proved the existence of at least one other human being of the Piltdown race. This was followed by an address by Mr. E. A. Martin, giving a general summary of what is known of the early types of man and their implements. Prof. MacBride raised a burning question in his paper, "Are Acquired Characters Inherited?" and dealt to some extent with the experiments of Kammerer on newts and salamanders, claiming that as a result the question asked in the title of his paper could be answered in the affirmative. In the discussion it was pointed out by Dr. Boulenger that some doubt had been thrown upon Kammerer's work.

A paper was read by Dr. J. S. Haldane on "Abnormal Atmospheres and the Means of Combating Them," followed by a visit to Messrs. Siebe, Gorman and Co.'s works at Westminster, under his guidance. Here William Walker, the diver who a few years ago so successfully laid foundations under peat and water for the then threatened Winchester Cathedral, gave an exhibition of the diver's work under water, in the great tank on the premises, where many a modern diver has been initiated into the art. A number of the guests, in Dr. Haldane's company, were then immured in a chamber while the pressure was raised to nearly two atmospheres, while another party entered a second chamber in which the pressure was reduced to nearly half an atmosphere.

On June 8 a party of seventy persons enjoyed a visit to a large munitions factory in the East of London, employing 2700 men and 800 women, where the manufacture of shells proceeds with a possible output of 16,000 a week. Here the whole of the making of a shell was seen, except the filling, from the time that the steel billet is put into the furnace to the time when it is passed into the hands of those who test them to detect faults in completed shells. The accuracy observed in the making is so fine that those cast out are but a small fraction of one per cent. Another party accompanied Prof. G. S. Boulger to the Chelsea Physic Garden, and listened to a paper read by the guide, whilst Dr. Boulenger entertained a large number at the Zoological Gardens with a paper on "Reptiles in Captivity," followed by a perambulation of the gardens. Variety was afforded by a paper on "Tokens of London," by Mr. W. Dale, and a lecture by Dr. Daydon Jackson, the secretary of the Linnean Society, on "Famous Trees and Gardens of London." At the delegates' final meeting Sir Daniel Morris, K.C.M.G., was chosen to be president for 1918–19, but the place of meeting has not yet been decided upon.

THE FUTURE OF THE X-RAY INDUSTRY.

THE future of the British X-ray industry will depend upon the ability of the British manufacturers to hold their own against those of other countries. The world's markets will be captured by that country which can combine the largest capital with the greatest initiative and fertility of invention. British manufacturers in other directions in the past have been able to hold their own; there is no reason why the British X-ray industry, if sufficiently capitalised and guided by the best skill in the country, should not be able to do the same in open competition with other countries.

American manufacturers have already advanced to the stage of amalgamation and pooling of interests. The capital invested amounts to a considerable sum—250,000*l*., or thereabouts. This means active propaganda in the future and severe competition in all markets. On the Continent the industry has been fostered by several large electrical firms, which by virtue of their resources and capital have been able to initiate research and perfect the technical details of the apparatus.

In England up to the present such methods have been conspicuous by their absence; the trade has been in the hands of a number of small firms, the combined capital of which would form only a fraction of that invested in the American amalgamation. It would appear, then, that if British firms are to hold their own and command a share in the world's markets, a determined effort must be made now to reorganise the industry. Co-operation is urgently needed; financial aid must be forthcoming either in the form of a Government subsidy or by private endeavour. Another important step would be the formation of an advisory committee consisting of physicists, medical men, and technical experts. The duties of this committee would be to advise on new apparatus and the best methods to employ for its production. Such a committee might also act in an advisory capacity to hospitals and medical men on technical and other points.

We welcome the announcement of the formation of a section of the British Electrical and Allied Manufacturers' Association as a step towards this end. "Already the section has been able to co-operate with the Government in research work connected with the improvement of essential instruments, and it is hoped that this will only be a preliminary to wider investigations." The field is a wide and an ever-increasing one, and well worthy of the consideration of financiers as a profitable investment for capital.

The keynote to success is efficiency, and none but the very best technical apparatus can hope to hold its own in the world's markets. Initiative in the organisation of the industry and the production of new types of apparatus would be the first step towards the recovery of a place in the world's markets. Publicity is another step towards that end; this must be secured by collaboration with the radiologists, who by attracting workers from all parts of the world would direct their attention to the apparatus used in the clinics and teaching centres throughout the country. Side by side would arise an active British School of Radiology and a large industry devoted to the perfecting of the apparatus used in the various departments of its activity.

THE ARGENTINE SOCIETY OF NATURAL SCIENCES.

THE Argentine Society of Natural Sciences, founded on the plan of the British Association and kindred societies, held its first general meeting in Tucuman at the end of last November, and at the same time celebrated the centenary of the foundation of the Argentine Republic. The society began its activities five years ago by the publication of an excellent small journal, *Physis*, which we have several times noticed; and it intends in future to hold a biennial congress, by which the aims and progress of science may be made more widely known to the people. Its founders realise that hitherto scientific studies in the Argentine Republic have been prosecuted chiefly by foreign travellers and by foreigners temporarily resident in the country; and they hope, by a more systematic organisation of university teaching, and by rousing the federal and provincial Governments to a more sympathetic attitude towards scientific research, to follow up this pioneer work at home. We appreciate their ambition, and wish the society all success.

The congress in Tucuman was welcomed by the Governor of the Province in an appropriate speech, and its scientific session was opened by the address of the president, Dr. Angel Gallardo, director of the National Museum, Buenos Aires. Dr. Gallardo, as a distinguished biologist, referred to the studies to which he has devoted his life, and explained in a popular manner the fundamental importance of biological research to modern man, especially in such an environment as that of tropical and sub-tropical South America. He briefly reviewed the methods to be followed, and incidentally alluded to the manner in which Darwin's work on the pampas aided him in propounding his theory of evolution. He also mentioned with natural pride the important researches of the late Dr. Florentino Ameghino on the fossil mammals of Argentina, which made known a new world of life and led to speculations of great interest.

The technical work of the congress was arranged under eight sections: I. Geology, geography, and geophysics, presided over by Dr. E. Hermitte, who spoke of the economic applications of geology; II. Palæontology, with Dr. Carlos Ameghino as president; III. Botany, presided over by Dr. C. M. Hicken, who referred to some features in the flora of Tucuman; IV. Zoology, with Dr. E. L. Holmberg as president; V. Anthropology, ethnology, and archæology, with

Dr. J. B. Ambrosetti as president; VI. Physics and chemistry, under the presidency of Dr. E. H. Ducloux, who discussed the chemistry of chlorophyll; VII. Applied science, presided over by Dr. T. Amadeo, who urged the importance of a well-organised national institute for agricultural research; and VIII. Teaching and history of natural science, presided over by Prof. V. Mercanti, who discussed the teaching in the national colleges and normal schools. Papers were numerous, especially in reference to Tucuman, and among the evening lectures was a valuable discourse by Dr. Hermitte on the petroleum worked at Comodoro Rivadavia.

The next congress is to be held at Mendoza, and it is hoped meanwhile to establish in all the provincial capitals institutes or societies to work in association with the Argentine society.

EDUCATIONAL RECONSTRUCTION.

THE appreciation of the urgent need for an immediate improvement and extension of the supply of educational facilities for all sections of the population is common alike to administrators of education and to teachers of all grades. During recent months special meetings of associations of educational workers of many types have been held, at which reports and resolutions have been adopted, which summarise the experience gained in various localities and in all kinds of educational institutions.

One of the latest competent authorities to issue a report on educational reform is the Association of Education Committees. Since June of last year the executive committee of this association has been considering important educational questions, with the object of contributing help to our administrators in the task of educational reconstruction to which they are committed. It is impossible here to enumerate all the recommendations included in the comprehensive report recently issued by the association, but attention is directed to the importance attached in the report to the necessity for an adequate provision of instruction in science. The general tenor of the replies to a question on the subject from education committees throughout the country is that in the elementary schools the rudiments only of science can with advantage be taught, between the ages of twelve and fourteen, and that it is not desirable to extend the range of the science teaching given in these schools much, if any, further than at present. In secondary schools, however, there is a large majority in favour of an increase of science teaching. With this view the executive committee concurs, but thinks that the science teaching to be given in elementary schools should be made general, and should proceed upon much more definite and systematic lines than it does now. In many schools science is the last subject considered in framing the time-table, and any kind of equipment, or none at all, is often considered adequate, while the training of teachers, other than specialists, for giving good lessons in science is often very defective. The committee desires to record its emphatic opinion that it is essential in the best interests of the nation that much more attention should be given to the teaching of physical science in every type of school. It should be made impossible for any child to leave school without having had a full opportunity of learning at least the basic principles of science. In elementary schools the teaching can only be elementary, but, even so, it must be adequate. In secondary schools science should be the basis of the teaching on the "modern side," and that side should be of equal standing with any other. The mistaken view which puts science in antagonism to the older features of a liberal education should be vigorously combated.

So far as continuation classes are concerned, the report reveals some diversity of opinion. Of the one hundred and two education committees which replied to the question on the desirability of compelling children who have left school to attend classes for further education, only twelve were opposed to the introduction of compulsion. Of the remainder, a few would carry on the further education only to the age of sixteen or seventeen, while sixty-five were in favour of compulsion up to eighteen. On the important point whether such education should be given in the daytime, or in the evening as now, only eight committees out of one hundred and six were in favour of a continuance of entire evening teaching, though some others thought that a part of it might be given in the evening.

The Association of Directors and Secretaries for Education, which includes the chief administrative officers for counties and county boroughs throughout England and Wales, has issued a series of resolutions dealing with important educational questions requiring legislative or administrative action. Among the resolutions of particular interest are the following:—In the interests of the State no child or young person should be debarred by lack of means from the highest education of which it is capable. The upper limit of compulsory full-time attendance at the elementary school should be raised universally to fourteen years. The power of local education authorities to supply or aid the supply of education other than elementary, as provided by the Education Act, 1902, should remain unimpaired. It should be the duty of local education authorities to make adequate provision of such forms of higher education as are needed for their areas. The limitation of the amount which may be raised by rate under the Education Act, 1902, section 2 (1), should be removed. It is desirable in the interests of educational efficiency as well as of economy that the Board of Education should resume its statutory powers with regard to agricultural education and should provide itself with the necessary expert staff. A system of compulsory day continuation schools should be established, with a minimum of eight hours' instruction per week, or at least 320 hours per year, between the ages of fourteen and eighteen years, the instruction to be given between the hours of 8 a.m. and 6 p.m. An obligation should be laid (1) on all employers to allow full time for instruction, including time for travelling, without deduction of wages; (2) on parents and pupils as to attendance; and (3) on local education authorities to make the necessary provision. The total hours of labour and of school attendance during the continuation-school period should not exceed forty-eight per week. The possession of an approved certificate testifying to the completion of a satisfactory course in a secondary school ending not earlier than sixteen years of age should entitle the holder to exemption from compulsory continuation-school attendance between sixteen and eighteen years of age. Adequate provision of scholarships from elementary schools to secondary and technical schools, and from secondary schools to places of higher education of university rank, should be an integral part of each authority's scheme.

The Association of Technical Institutions also has drawn up a programme of educational reform, with special reference to technical instruction, which should assist the Board of Education in its important task of extending and completing our system of national education.

A special committee was appointed by the association consisting of the council and six representatives

of institutions outside the council. This committee has formulated a series of resolutions, which are now issued with the general approval of the members of the association, and among them the following may be noted:—

That the Government be asked to prevent any child leaving school before the end of the term in which the child attains its fourteenth birthday; that the State should make adequate grants for the maintenance of free scholars proceeding from primary schools to secondary and junior technical schools; that there shall be instituted compulsory attendance at continuation classes up to the age of eighteen years, such attendance to be made in the daytime, and the period of instruction to be not less than eight hours per week, such hours to be within the normal hours of employment; that the conditions for admission to universities should be reconsidered and rendered more uniform as between different universities, and less uniform as between different faculties and different honours schools in the same university, and that in the interest of candidates of mature age and of other candidates approaching the university otherwise than through the normal avenue of the secondary school, university entrance tests should be distinguished from secondary-school examinations; that it is desirable that there should be a large increase in the number of scholarships with adequate maintenance grants to enable candidates to proceed to day technical colleges; that teachers in technical departments of universities and technical colleges be encouraged to undertake research on behalf of, and in co-operation with, manufacturing firms: that in view of the national importance of technical education the State should bear a much larger proportion of its cost than is now the case; that Government grants in aid of technical research should be largely increased; that it is essential that the chief officials of the Technological Branch of the Board of Education should have had a scientific training; and that the examinations of the Civil Service and for other Government appointments, when not directly on the subjects of the service, should include such science subjects and syllabuses, and should be so marked as will give the student with a scientific training an equal chance with a student who has had a literary training.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Senate has elected Sir Cooper Perry, physician at, and superintendent of, Guy's Hospital, to the office of Vice-Chancellor for the year 1917–18, in succession to Sir Alfred Pearce Gould.

The thanks of the Senate have been accorded to the Right Hon. Lord Reay, K.T., for the gift of a portion of his library to the University for the University College libraries, and to Mr. George Hare for the gift of 50*l.* to found a zoology prize at King's College, in memory of his son, a medical student, who was killed at the battle of Gaza.

The following doctorates have been conferred:—*D.Sc. in Physiology*, Mr. S. W. Patterson, an internal student, of University College, for a thesis entitled "The Action of Carbon Dioxide and Adrenalin on the Heart"; *D.Sc.* (*Economics*), Mr. J. E. Holloway, an internal student, of the London School of Economics, for a thesis entitled "The Prelude to the Great Trek"; *D.Sc. in Zoology*, Mr. Cyril Crossland, an external student, for a thesis entitled "Desert and Water Gardens of the Red Sea," and other papers.

OXFORD.—Sir Napier Shaw, Director of the Meteorological Office, has been appointed Halley lecturer for 1918.

The School of Geography has published its arrangements for the ensuing Michaelmas term. These include lectures, tutorial instruction, and field work. Among the subjects announced are:—"Maps: their Construction and Interpretation"; "The Alps and Northern Italy," Mr. Beckit; "The British Isles," Miss MacMunn; "Eastern Australia and New Zealand," Mr. Spicer; "Geology," Prof. Sollas; and "Historical Geography of Great Britain," Mr. Grant Robertson.

A list of lectures and other courses of instruction for the forthcoming term has also been issued by the Department of Anthropology. In physical anthropology lectures will be given by Prof. Thomson and by Miss Czaplicka, the latter on ethnology. The geographical distribution of man will be dealt with by Mr. Beckit. Mr. H. Balfour, Prof. Sollas, and Mr. Griffith will lecture respectively on prehistoric archæology, on stages of human culture, and on ancient Egypt. Various topics of social anthropology will be taken in hand by Dr. Marett, Sir P. Vinogradoff, Prof. Macdonell, Mr. V. A. Smith, and Mr. Blunt. Prof. Wright will lecture on philology, and Prof. J. A. Smith on primitive language in its relation to thought.

MR. T. H. BICKERTON has been appointed lecturer on ophthalmology in the University of Liverpool in succession to Mr. E. A. Browne, who has resigned the position.

THE title of Emeritus professor has been conferred upon Col. de Burgh Birch, until lately professor of physiology and histology, and dean of the faculty of medicine, in the University of Leeds.

THE proceedings at the annual general meeting (March 29) of the Council of Education, Witwatersrand, published in a report just received from Johannesburg, show that we were right in our article of August 10 last year when we said that apparent grievances and jealousies would end in a unanimous effort to establish a real university for Witwatersrand. We wish we could hope that the present entrance examination for the diploma of the School of Mines might be regarded as sufficient for matriculation in the new university, at all events for undergraduates proceeding to science degrees.

AMONG the many problems connected with engineering upon which experience gained during the war has shed fresh light is that of the workshop training of apprentices. An article which appears in *Engineering* for June 22, by Mr. Neil J. Maclean, gives an interesting account of the system which has been in operation for twelve years at the works of Messrs. Barr and Stroud, Ltd., Glasgow. The author lays down six axioms which should be borne in mind in instituting any apprenticeship system. (1) The apprentice must be always busy, thus necessitating the time and attention of a skilled man. (2) The apprentice must be always learning; he must be taught to do a certain thing properly, and must then be moved on to a different kind of work. (3) Engineering is an exact science, and the apprentice must develop the scientific mind; to obtain the desired result, the training must involve an intimate mingling of practical and theoretical work, of shop experience and study, of things seen and done, things noted and written down. (4) The apprentice's course of training must not be determined by the shop foreman or manager responsible for output; in our opinion, the author touches a fruitful source of grievance here. A lad does well at a certain job, and the foreman keeps him at it in order to maintain output, regardless of the loss of experience to the apprentice and the ultimate loss to the firm.

(5) There cannot be too many highly trained apprentices. (6) Special training must be given to those apprentices who show marked ability. The article is very interesting to all concerned in the training of apprentices, and throws light on one reason for the success of the well-known firm mentioned.

PROF. IGNAZIO GALLI has an article, "Sulla questione della lingua internazionale," in a recent number of the *Atti della Pontificia Accademia Romana dei Nuovi Lincei.* Among arguments in favour of a common international language he lays stress on its convenience at scientific congresses. Those who attend such meetings must have noticed that when each member uses his own language the discussion often shows that a speaker has imperfectly understood much that has been said in a language foreign to him. As regards the choice of the international language, Prof. Galli finds that Volapük is too complicated and difficult to pronounce. Esperanto is easy to pronounce, since it gives to each letter of the alphabet only one sound. Prof. Galli thinks that the belief that Esperanto would become a universal language is steadily losing ground, and that this is due to its too artificial simplicity, which renders this language meagre and rather vague. We are told that Ido has a more rational selection of words than Esperanto, while Simplo, a language invented by Mario Ferranti, has about 5800 words, which are formed from roots common to Latin, Italian, French, and English. Finding none of these artificial languages to be sufficiently flexible to express all the ideas of modern science and philosophy, Prof. Galli strongly urges that instead of wasting energy in the creation of a new language, Latin should be adopted as a common language for international intercourse. He proposes that Latin should be taught in schools, not as a dead, but as a living, language. Men of all nations would then converse freely when they met, as the learned could in the days of Roger Bacon. In connection with Prof. Galli's suggestion, it is worth while to mention that Latin and Greek are both taught as living languages at the Perse School, Cambridge, with very successful results. A letter on "Latin as a Universal Language," by the late Sir Lauder Brunton, appeared in NATURE of February 10, 1916 (vol. xcvi., p. 649).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 14.—Sir J. J. Thomson, president, in the chair.—Prof. T. H. **Havelock**: Some cases of wave motion due to a submerged obstacle. In this paper Prof. Lamb's solution for a submerged circular cylinder is carried a stage further in the approximation, and the wave resistance is calculated directly from the resultant fluid pressure on the cylinder. Similar methods are then applied to a three-dimensional problem, the waves produced by a submerged sphere.—Prof. L. V. **King**: The propagation of sound in the free atmosphere and the acoustic efficiency of fog-signal machinery.—H. J. **Shannon,** F. F. **Renwick,** and B. V. **Storr**: The behaviour of scattering media in fully diffused light. The paper deals with the relationships between the rejectance (proportion of incident light rejected), the obstruction (ratio of incident light to transmitted light), light capacity (ratio of accepted light to transmitted light) when a sheet of diffusing medium is illuminated on one side by diffuse light, and also the relative obstruction, and relative density, when, as in various instruments, the source of light is a first sheet of diffusing medium in contact with the sheet being examined. The experimental part of the paper discusses the method of using the theoretical equations obtained for determining the constants of a specimen of diffusing medium, certain requirements of the instrument used, and precautions to be taken. Examples are given showing the close agreement between observed and calculated values up to seven thicknesses of opal for both air and oil contact.—J. W. T. **Walsh**: The theory of decay in radio-active luminous compounds. The theory of destruction of "active centres" put forward by Rutherford to account for the decay of luminosity of radio-active luminous compounds leads to a simple exponential relation in the special case of a compound of constant activity. It has been found for radium zinc sulphide compounds that this relation expresses the observed results to a sufficient accuracy over short periods of less than 200 days, but that it fails to do so over longer periods, such as 500 days, the rate of decay of luminosity becoming gradually slower and slower, so that the brightness tends to a limiting value which is not zero. The paper is an attempt to find a luminosity time relation which will allow of the prediction of the ultimate behaviour of compounds of varying composition, and it assumes the operation of some factor acting in a direction opposite to that of the destruction of the active centres.

Physical Society, June 8.—Prof. C. V. Boys, president, in the chair.—T. **Parnell**: An alternating-current bridge method of comparing two fixed inductances at commercial frequencies. The paper describes a method of avoiding the troublesome double adjustment required in Maxwell's method of comparing inductances. A current detector, the deflections of which depend on the component of the current in quadrature with the E.M.F., is employed, which makes it possible to arrange that the condition for no deflection depends chiefly on either the inductances or the resistances. In series with the bridge is placed either a non-inductive resistance or a capacity. In the first case the balance depends chiefly on the inductances, and in the second case on the resistances. A few alternate repetitions of the two adjustments suffice to balance the bridge, both for resistances and inductances. As detector a sensitive moving-coil galvanometer in conjunction with a commutator, or a Sumpner electrodynamometer, may be employed; the latter proved more satisfactory.—Balth. **Van der Pol,** jun.: The wave-lengths and radiation of loaded antennæ. The paper consists of a mathematical treatment of the subject, the following being some of the conclusions arrived at:—The radiation resistance of a loaded antenna, and also the radiation from the antenna, are dependent not only on the wave-length, but also on the current values at the top and bottom. The radiation cannot, therefore, be written $\Sigma = AT^2l^2/\lambda^2$, where A is constant and T is the R.M.S. current at the base, as is done in most text-books. Rüdenberg's formula for flat-top or umbrella antennæ is valid only for very long wave-lengths, with a capacity at the top of the antenna very large compared with that of the vertical part, and Austin's table of radiation resistances up to ratios of $l/\lambda = 0{\cdot}4$ is based on an unjustifiable extrapolation of Rüdenberg's results. The paper also treats of the directions in which the energy is most strongly radiated under different conditions.—Dr. A. **Griffiths**: A method of preventing sparking at a rapid make-and-break, which incidentally produces colloidal platinum. The apparatus exhibited was described in the *Philosophical Magazine* for March, 1895, p. 232. The device consists of a series of electrolytic cells placed as a shunt across the spark-gap. The electrodes consist of platinum, and the electrolyte of strong sulphuric acid. The cells polarise, and on making the gap an E.M.F. is introduced opposed to the E.M.F. of the battery, so that the

current rapidly diminishes, decomposing the liquid and doing chemical work. The author made the following statements:—(1) The platinum cathodes disintegrate and a colloidal solution of platinum is formed. (2) The cathode on the negative side of the spark-gap generally disintegrates to the greatest extent; the next cathode disintegrates less, and so on, the least disintegration occurring in the cell at the positive side of the spark-gap. (3) The cathodes develop, to the naked eye, an appearance as if they were covered with platinum black. Certain plates examined under the microscope seemed covered with numerous craters. (4) The production of gas does not appear to be the same in each of the electrolytic cells in series; sometimes no gas at all appears to be evolved from the most negative cathode. (5) The rate of disintegration of a cathode appears to be small when the cathode is first placed in the sulphuric acid, and appears to increase to a maximum in course of time. (6) One specimen of platinum appears to behave differently from another.

Royal Meteorological Society, June 20.—Major H. G. Lyons, president, in the chair.—C. E. P. **Brooks**: The reduction of temperature observations to mean of twenty-four hours, and the elucidation of the diurnal variation in the continent of Africa. Mean temperatures obtained from various combinations of observations should be reduced to true mean or mean of twenty-four hours to make them comparable. This is generally done by interpolation, but interpolation is not possible in Africa. An alternative method is given by representing the diurnal variation of temperature by means of the first two terms of a Fourier series—$Th = a_0 + a_1 \sin(H+A_1) + a_2 \sin(2H+A_2)$. This gives six variables, and a_0 can be found if we have three observations a day and two of the constants. a_1 and a_2 can be calculated from mean maximum *minus* mean minimum, and the reduction of various combinations of hours to true mean is discussed on these principles, and the connection of the various constants with physical factors is also discussed.—F. J. W. **Whipple**: Autographic records of the air-wave from the East London explosion, January 19, 1917. The records which were made use of in this investigation were of two kinds, those from ordinary barographs and those from the recorders used for indicating the pressure in gas mains. The gas engineer measures the difference between the pressure in his mains and the pressure of the air so that his instruments show sudden changes in air-pressure, as well as the barographs, and on a much more open scale. As a large number of records were available in the neighbourhood of London, it was possible to map in some detail the intensity of the air-wave from the East London explosion. A measurable disturbance was shown as far to the north-west as Enfield, and as far south as Whyteleafe, but the range to the north-east was very restricted.—R. C. **Mossman**: Some aspects of the cold period, December, 1916, to April, 1917. In the course of his remarks the author said that the mean temperature of the British Isles during the period under notice, taking the mean of the twelve divisions used in the Monthly Weather Reports of the Meteorological Office, was 1·9° C. below the normal, the extremes ranging from −2·8° C. at Belvoir Castle, in Leicestershire, and −2·7° at Newquay, to −0·5° at Castle Bay, in the Hebrides. The cold, except in December, was general over Western Europe, the mean temperature of Sweden being 1·9°, of Holland 2·7°, and of Norway 1·5° below the average, whilst as far south as Gibraltar the mean was 1·1° under the average. It was shown that when the eastern portions of the British Isles had a mean temperature below the normal in each month from December to April, an event that had only occurred on five occasions in the last century and a half, there was then a pronounced tendency for the depression of temperature to continue without interruption until the end of the year. The only exception occurred in 1808, when a warm period covering the four months, May to August, was sandwiched between two cold spells. The frequent absence of historic frosts during long periods of uniform cold over the British Isles was also referred to.

EDINBURGH.

Royal Society, May 21.—Dr. J. Horne, president, in the chair.—Capt. **Miller** and Dr. H. **Rainy**: Observations on the blood in gas poisoning. From a study of fifty cases, they found that in all cases of any degree of severity there was a change in the relative proportions of the different kinds of white-blood corpuscle, the lymphocytes being proportionately much increased. This increase in any marked case is sufficiently striking to be of some importance when the medical officer is in doubt as to the trustworthiness to be placed upon the statements of men complaining of being gassed. The change is one which develops early, probably within a month of the gassing, and continues for a long time. It appears to be independent of the kind of gas, and is shown by patients exhibiting many varieties of symptoms. It is not clear what the change is due to; but it is probable that chronic inflammatory change in respiratory and gastric mucous membranes is at least a factor.—H. M. **Steven**: The Chermes of spruce and larch and their relation to forestry. For the development of the Chermes group of aphids two hosts are normally required and a period of two years. The one host is a species of spruce, and the other may be a species of larch, pine, or silver fir. A description was given of the biology of the species of the genera Chermes and Cnaphalodes, which occur on larch and spruce, and it was shown that there were separate and independent cycles on spruce only. The cumulative damage done on larch is frequently very severe. Experiments on the fumigation of coniferous nursery stock were now being carried out, and it was hoped to ensure that trees planted out on an area would be free from infection, and thus the further spread of the Chermes would be checked.—F. L. **Hitchcock**: The square root of a linear vector function. The purpose of this paper was to examine and classify the various cases in which a solution could be obtained of the functional equation first studied by Tait, namely, $\phi^2 = \psi$, where ψ is a given linear vector function and ϕ is to be found.

PARIS.

Academy of Sciences, June 11.—M. A. d'Arsonval in the chair.—A. **Carnot**: Ammonio-cobaltic molybdate, tungstate, and vanadate. The estimation and separation of cobalt.—C. E. **Guillaume**: Changes in the expansion of the alloys of iron and nickel under the action of various thermal and mechanical treatments. An account of the changes in the expansion of invar by varying thermal and mechanical treatment has been published already. The present paper gives results obtained with other nickel-iron alloys, containing from 27·5 to 69 per cent. of nickel.—G. **Charpy** and M. **Godchot**: The conditions of formation of coke. The quality of the coke in these experiments was defined by the resistance to compression, expressed in kilograms per square cm., and exact details are given of the method of preparing the test cylinders. The influence of temperature of coking on the strength of the coke was very marked.—M. Leclainche was elected a member of the section of rural economy in succession to the late M. A. Chauveau.—G. **Julia**: Indeterminate

conjugated biquadratic forms with integral coefficients.—J. **Renaud**: Points of identification, in times of fog, of the great French ports on the Atlantic Ocean.—P. **Chevenard**: A self-recording differential dilatometer. Two test pieces, one of a standard chrome nickel alloy ("*baros*") of known coefficient of expansion, are arranged to move an optical lever, the magnification being about 300. Curves are given for a ferro-nickel (59·2 per cent. nickel), electrolytic iron, and forged nickel.—J. **Repelin** and L. **Joleaud**: Limits of the marine Aquitanian in the Provençal region.—H. **Jumelle**: The palm-trees producing vegetable horsehair of Madagascar.—L. **Bordas**: The function of some Ichneumonides as auxiliaries in forestry. Two species of Pimplinæ—Rhyssa and Ephialtes—assist in the defence of forests against the attacks of Sirex and Callidium. The Ichneumons deposit their eggs in the larvæ of Sirex and other pests, and in consequence are of great service in the preservation of forest trees.—J. **Pavillard**: Some new or slightly known Protozoa of the Mediterranean plankton.

CAPE TOWN.

Royal Society of South Africa, April 18.—Dr. L. Péringuey, president, in the chair.—Sir Thomas **Muir**: Note on the expansion of the product of two oblong arrays. The form taken by Binet and Cauchy's well-known expansion of the year 1812 is that of a sum of products of pairs of determinants; the form of the expansion now given is that of an aggregate of single determinants. The relation between the two is explained and a historical remark added.—J. S. v. d. **Lingen**: Notes on radiation of crystals. (1) Radiation patterns of the transformation of magnesium hydroxide to magnesium oxide. The patterns show that the reflecting planes of the crystal are disturbed when water is driven off. The "spots" become drawn out into radial lines, and these radial lines reflect the intensity of the X-ray spectrum. (2) Diamond tests by radiation patterns. The following stones were examined:—"Macle," "spotted" stone, "spotted rejection" stone, and an "inferior brown block" with a spot in it. The patterns show that a "spot" in a stone causes a discontinuity in the intensity of individual spots of the patterns, and that a fracture of the lattice causes a discontinuity of the spots so that they now represent irregular markings on the plate. An ideal diamond's pattern shows a uniform intensity in all the spots. (3) Bultfontein apophyllite, (i) ideal, and (ii) showing a cleavage crack along a cleavage plane. The flaw causes the spots of the "flawed" crystal to present a nebular appearance, whereas the ideal stone shows a uniform distribution of intensity in the elliptic spots. This represents a case of discontinuity in the lattice normal to the incident rays. (4) Serpentine, malachite, and pseudomorph quartz. Serpentine shows a regular "radial line" pattern symmetrical to a line parallel to the threads of the crystal. This indicates that serpentine is not triclinic unless every specimen examined was a "twin." Malachite shows three "lines" parallel to the threads and some minor radial lines normal to the former deviating slightly from the normal. Crocidolite: A long exposure shows that it is microcrystalline and that the elementary units have a tendency to favour a direction parallel to the threads. (5) A square-plate of iodine showed, after an exposure of about an hour, a diffraction phenomenon similar to that described by Prof. Laub, of Buenos Aires. In this case the plate shows diagonal lines of zero intensity.—S. **Schönland**: A summary of the distribution of the genera of South African flowering plants (with special reference to the flora of the Uitenhage and Port Elizabeth divisions). This is to a large extent based on published data, checked and enlarged, however, by the author's personal knowledge. It was compiled in connection with a study of the flora of Uitenhage and Port Elizabeth, but it is hoped that it may be welcome to other botanists who desire to have readily available a summary showing the general trend of distribution of South African genera.—Prof. G. Elliot **Smith**: Note upon the endocranial cast obtained from the ancient calvaria found at Boskop, Transvaal (see p. 353).

BOOKS RECEIVED.

L'Œuf et les Facteurs de l'Ontogénèse. By Prof. A. Brachet. Pp. 349+xii. (Paris: O. Doin et Fils.) 6 francs.

The Organisation of Thought: Educational and Scientific. By Prof. A. N. Whitehead. Pp. vii+228. (London: Williams and Norgate.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 28.

ROYAL SOCIETY, at 4.30.—Contribution to the Study of the Magnetic Properties of Manganese and of some Special Manganese Steels: Sir Robert Hadfield, Ch. Chéneveau, and Ch. Géneau.—Note on the Specific Heat of Water: W. R. Bousfield.—The Specific Heat of Aqueous Solutions, with Special Reference to Sodium and Potassium Chlorides: W. R. Bousfield and C. Elspeth Bousfield.—The Rankine Trochoidal Wave: Sir George Greenhill.—The Tribo-electric Series: Dr. P. E. Shaw.—And other Papers.

MONDAY, JULY 2.

ARISTOTELIAN SOCIETY, at 8.—Relation and Coherence: Miss L. S. Stebbing.

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THURSDAY, JULY 5, 1917.

THE CLASSICAL SYSTEM OF EDUCATION.

Higher Education and the War. By Prof. John Burnet. Pp. x+238. (London: Macmillan and Co., Ltd., 1917.) Price 4s. 6d. net.

PROF. BURNET'S book is entitled "Higher Education and the War." He states that most of his criticisms were published in 1913 and "are not, therefore, unduly influenced by the war." That they have been somewhat influenced thereby is thus admitted; this is the chief way the war comes in, for the work is mainly an appreciative account of the German system of higher education.

As such it will be useful if only to show those people who are ignorant of the fact—and they are legion, as the letters from clergymen and others which so frequently appear in the newspapers indicate—that this system is more completely based on the "humanities" than that of any other country—was, in fact, until the end of the nineteenth century practically confined to them. Until the present century no one in Germany could enter a university, or become a member of the Civil Service, or embrace any of the learned professions without a passing-out or maturity certificate from one of the "Gymnasien." The curriculum in these is almost purely classical, for of the nine years spent in these schools all have to be devoted to the acquisition of Latin and six to that of Greek, other subjects being allowed to play a very subsidiary part in the scheme of education, whilst science teaching is practically nil. This is an ideal "humanistic" education, carried out with all the disciplinary thoroughness of the German. All the governing classes of Germany of the present day were reared upon it—with the results which we are now experiencing. Prof. Burnet seriously suggests that we should adhere to such a plan of education for this country; and there are many people who agree with him. Did not the *Times* critic describe his book as "so good that it is difficult to review," and discover "nothing to find fault with" in it?

Prof. Burnet's work is an obvious attempt to counteract the "Neglect of Science" agitation. Yet he is constrained to admit that very few of the greatest scientific discoveries have been made by Germans (he might almost have said, none); what they have done is to organise scientific work. He states that for ourselves "what is wanted is really a better education for the leaders of commerce and industry, so that they may gain a rather wider outlook than they have at present." And for this wider outlook Prof. Burnet offers this German system. He tells us that the Prussians understand these things better than we do; that they organised their educational system to train an *élite* to do the highest work of the nation. "We have been furnished with such an *élite* by the public schools and by Oxford and Cambridge," which "do much of the best educational work that is done in this country to-day, and we should be careful not to meddle rashly with institutions which are more and more, becoming the envy and admiration of Europe and America."

Since the beginning of the present century some modification has been introduced into the German system, admission to the universities and the rest being possible through schools other than the Gymnasien proper. But although these devote less time to Latin than the Gymnasien, and still less to Greek, the education of the boys is almost entirely confined to languages and literature, so that it remains emphatically literary in character. And it may be added that these alternative schools, perhaps because they are new, are looked down upon by the higher social classes in Germany, so that the purely classical Gymnasien are yet by far the most frequented by those who desire to enter the universities, the Civil Service, and the learned professions. The whole German system, in fact, even with the modification alluded to, is based upon the idea—which Prof. Burnet strongly upholds—that the mind can be trained only by the study of languages and literature—preferably those of extinct races—as distinct from the modern English and American view that the intelligence can be developed as well, if not better, by the study of natural science, and that it is inexpedient to put all boys and girls through the self-same educational mill irrespective of their innate tendencies, and regardless of the fact that the particular mill which the humanists advocate is neither more nor less than abhorrent to the majority of healthy-minded children. Indeed, like most other humanists, Prof. Burnet holds that an education based upon the acquisition of knowledge which is of no value in after life is more useful than one based on knowledge which is of permanent value, and regards the sarcastic definition of education as "the sum of all we have forgotten" as a not altogether unjust appreciation of what education really should be. He considers that "the right of children to be treated as human beings," which in his view is to have their school training based entirely upon "humanistic" studies, is now seriously threatened by those who hold that the future of education may, and must, be strengthened by the introduction of a basis of natural science.

Prof. Burnet's contentions are not without such discrepancies as are inseparable from the pursuit of a weak line of argument. For while he contends that the Latin rather than the English grammar ought to be taught first, "when the memory is strong and the reasoning powers undeveloped. Children love to learn things by heart, whether they understand them or not. . . . On the other hand, they resent, and quite rightly, all appeals to their reasoning powers," he states, a little further on,

that "the Humanist ideal of education . . . is that the pupils should above all be led to feel the meaning and worth of what they are studying." This, one would have thought, is very much the ideal of those who advocate the introduction of the study of natural science into general education. Incidentally, one wonders to what kind of children Prof. Burnet alludes in the sentence above quoted, for the experience of most people surely is that an intelligent child wants to know the how and the why of everything!

Prof. Burnet's conclusions are that all boys (and girls?) should be educated on strictly classical lines until the age of seventeen, and that during the next three years the "humanistic" character of the education should be continued by compelling philosophy to hold the central place in the scheme. The rest of the organisation of their education would then present no difficulty to Prof. Burnet, but if the student continues with the "humanities," he ought to have a smattering ("know something") of science; if he goes in for science, he ought to continue with the "humanities." Prof. Burnet admits that at present students who are to proceed with the "humanities" show little desire to add a knowledge of science to their attainments, and certainly most students who have adopted science show no desire at all to continue with the "humanities"! At the end of the three years of philosophy, *plus* the "humanities," *plus* science, he would give an Arts degree, which must be a preliminary to all other degrees and would "mark the commencement of university work proper"; this degree would, in fact, be the equivalent of the German school leaving certificate. Even the study of Medicine is not to be commenced until the Arts degree is attained—a crude reversion to the old, abandoned Oxford system.

Prof. Burnet admits that his scheme for students of medicine is not in accordance with professional opinion in this country, and contrasts this with the expressed opinion of German medical faculties in favour of their own system. "There can," he says, "be no doubt, I suppose, that the *average* qualifications of medical men in Germany are much higher than in this country, and the most natural explanation of this seems to be that they are better educated and more mature when they begin the study of Medicine." From extensive personal knowledge of medical men in both countries I may venture to differ entirely from Prof. Burnet as to the correctness of his supposition—the reverse being, in my opinion, true—but I would be diffident in ascribing this to differences in scholastic training, seeing how much better organised is the teaching in our medical schools as compared with that in German universities. The superiority of the latter institutions has hitherto lain in the opportunities afforded in them for research—but that is another story.

E. A. SCHÄFER.

APPLIED CHEMISTRY IN THE UNITED STATES.

Annual Chemical Directory of the United States. Edited by B. F. Lovelace. Pp. 305. (Baltimore, U.S.A.: Williams and Wilkins Co.) Price 5 dollars.

THIS book, although primarily intended for circulation in the United States, has many features of interest deserving the attention of those who are concerned in the production of similar works in this country. It is a trade directory on a very broad gauge, and appeals to every section that is interested, even remotely, in chemical science and the chemical arts—industrial organisations of various kinds, scientific societies, colleges, professional analysts, consultants, chemical engineers, patent agents, manufacturers of chemical plant, etc. In view of the rapidly extending trade relations of America with the rest of the world, and especially with Europe, it affords a considerable amount of useful information on chemical matters in Continental countries. So far as we have been able to judge, it has been carefully compiled, although, as might have been anticipated in a work of this magnitude, a few omissions and occasional press errors are to be met with. Certain of the agricultural colleges and stations in this country are omitted from a list which professes to be comprehensive. No mention is made of several important schools of chemistry in Great Britain, and the list of technical colleges is incomplete. The list of officers of some of our scientific societies is also out of date. There are a few mistakes in the spelling of proper names, *e.g.* Brulington House for Burlington House, Wil for Will, etc.; but, considering the large amount of material to be dealt with, the number of such errors is remarkably small.

A valuable addition to the work is an annual review of progress in applied chemistry in the States during the year preceding publication. This for 1916 presents many features of interest. As might be expected, the war has had a profound influence on the course of development of the chemical arts in America, and there has been a great extension of chemical industry in that country. In 1914 the United States, like Great Britain, suddenly realised that it had grown to be largely dependent on Germany for hundreds of things of a chemical nature that were necessary for its daily comfort and convenience. This domestic demand, as well as the effort to meet the enormous foreign demand for munitions, etc., greatly stimulated all chemical industries in that country. The older concerns largely increased and improved their output, and in many cases branched out into new lines, and a number of new companies were organised and are now firmly established. So great is the demand for chemists that factories are offering attractive salaries to young men who have scarcely completed their academic training. This revival is, of course, reacting upon the colleges and schools

of chemistry throughout the country, and cannot fail to exercise an influence upon the progress of chemical research. Industries that have now been undertaken by American manufacturers cannot be permanently maintained unless continually fostered by research.

The Government has not been unmindful of its opportunity. Considerable "appropriations" have been made in support of the dye-stuff industry, the recovery of potash salts, the extraction of radium from carnotite ores, etc. A National Research Council has been founded, consisting of leading American investigators, and representatives of the defensive forces, the various scientific bureaux of the State, educational institutions, and the research departments of industrial and manufacturing establishments. The Chemistry Committee of the council has evidently been carefully organised, and contains within its body, as well as in its numerous sub-committees, dealing with practically every branch of applied chemistry, almost every representative man in the States. An immediate result is seen in the extraordinary development of the synthetic colour industry, a great variety of dye-stuffs hitherto made only in Germany being now manufactured in the States. It is not too much to say that America is now independent of German production. This extension has, of course, reacted on the coal-tar products industry and on the manufacture of "intermediates," acids, alkalies, ammonia, and a great variety of chemical substances. It has influenced, indeed, almost every branch of applied science and has affected the manufacture of all kinds of appliances, both for research and for technical processes. American instrument makers are now turning out ammeters, voltmeters and wattmeters, thermometers, scientific and industrial, pyrometers, glass-ware, silica apparatus, porcelain goods, etc., of a kind in no wise inferior, and in some cases actually much superior, to the best German and Austrian production.

This widespread activity has, it need scarcely be said, greatly stimulated the innate inventive genius of the American, and last year saw several novelties on the market of interest to chemists and physicists. Among them is *rhotanium,* an alloy of rare metals, having a specific gravity about half that of platinum, and capable of replacing that metal in the manufacture of crucibles, dishes, etc. Another new alloy is *canadium,* which is said to be specially suitable as resistance material in electric furnace windings, contact and spark points, and other electrical uses. *Clebrium,* another alloy, is said to be unacted upon by nitric, sulphuric, or acetic acid, and to be readily machined. New uses have also been found for *alundum* and *bakelite.*

Altogether the record of progress during 1916 is most satisfactory. We have reason to know that its rate is being maintained, and we shall look forward, therefore, with interest to the appearance of the second volume of what is undoubtedly a most useful compilation.

WAR MEDICINE AND SURGERY.

(1) *Les Dysenteries, Le Choléra Asiatique, Le Typhus Exanthématique.* Par H. Vincent et L. Muratet. Pp. 184. (Paris: Masson et Cie, 1917.) Price 4 francs.

(2) *Le Traitement des Plates Infectées.* Par A. Carrel et G. Dehelly. Pp. 177. (Paris: Masson et Cie, 1917.) Price 4 francs.

THESE two volumes belong to a series planned to deal with the medicine and surgery of war. War medicine and surgery differ considerably from civil practice, so that there is room for such a series.

(1) In this volume dysentery, cholera, and typhus fever are considered, not altogether a logical mixture, though all three diseases are of considerable importance under war conditions.

Each disease is dealt with under two divisions, the clinical features and the epidemiology and prophylaxis. Under the former the symptoms, diagnosis, and treatment are discussed, not at any length, but on the whole sufficient for the busy practitioner.

The two principal forms of dysentery, the bacillary and the amœbic, are described, and the causal agents and their principal characters detailed.

Under cholera the methods for the detection of the vibrio in the stools are described. Prophylaxis in each case is well done, and these sections are perhaps the best in the book. Vaccination for the prevention of dysentery and of cholera is dealt with at some length, but no mention is made of Castellani's mixed vaccines. Under typhus fever considerable space is devoted to the louse and methods for dealing with it. The weakest sections are those in which treatment is discussed. For bacillary dysentery practically no mention is made of the saline treatment, and for the amœbic variety the ipecacuanha treatment is very imperfectly described, and no reference is made to emetine-bismuth iodide. Similarly for cholera, while Rogers's hypertonic salt treatment is mentioned, the details given respecting it are too scanty to be of much value.

(2) Some months ago a system of treatment of septic wounds was described by Dr. Carrel. It consists, in brief, in the irrigation of the wounds every two hours with a hypochlorite antiseptic solution (Dakin's), tubes being inserted into the wound and retained there so that the irrigation may be carried out without disturbing the wound or patient. Considerable success is claimed for this method of treatment, and in this volume Drs. Carrel and Dehelly give full particulars how it is applied. Reproductions of photographs clearly illustrate the methods of arranging the irrigation tubes, so that every part of the wound shall be subjected to the irrigating fluid, and charts show the alterations in the microbic flora and the rate of healing of the wounds during the course of the treatment.

For those who have to deal with the wounded in the present war we strongly recommend a perusal of this book.

R. T. H.

OUR BOOKSHELF.

Horses. By Roger Pocock. With an Introduction by Prof. J. Cossor Ewart. Pp. x+252. (London: John Murray, 1917.) Price 5*s*. net.

THIS is an entertaining little volume, written by one who has spent much of his life among horses as a ranchman; and from the ranchman's point of view he surveys horsemanship the world over. As a standard of comparison this is useful enough, but, unfortunately, it has distorted his judgment. Hence he is led to assure us that "the pleasure horse and his equipment are so highly specialised for running and jumping that they have ceased to possess the slightest value for civil and military working horsemanship." Yet, as a matter of fact, a large proportion of British cavalry has been horsed during the present war by animals taken from the hunting-field. The best bred of these animals, indeed, are generally considered to make the finest cavalry chargers in the world. The author has some pertinent criticisms on our saddles and mode of riding, and on our treatment of horses in and out of the stable, which will at least repay careful consideration from those immediately concerned.

Of his own feats in the saddle he has much to say, and some of these indeed savour of the wonderful. They are, at any rate, eminently readable. Less entertaining are his sneers at the "scientist," whom he regards as "an amateurish, unpractical sort of person, who cannot either ride or cook"—these being the only accomplishments for which he has any regard. His confidence in his powers of observation, and his knowledge of the lie of the land, even in unexplored country, are so absolute that he has no use for either the compass or maps!

In a chapter on the origin of the horse—which he owes to the "scientist"—he assures us that "the bald skin of the pig is boldly painted in splashes of pink and brown to imitate the lights and shadows of forest undergrowth. The forest ancestors of the horse were bald and painted in the same way. . . ." Pink pigs may be seen in our farmyards in plenty, but we know of no wild race similarly coloured, and there is no reason for supposing that the forest ancestors of the horse were "bald."

If the author had adopted a less superior attitude his book would have been even more readable than it is.

Bacon's New Series of Physical Wall Atlases: British Isles. Scale 1:1,187,000 (18·7 miles to an inch). (London: G. W. Bacon and Co., Ltd.) Price 26*s*.

THE seven maps in this series vary a great deal in value. The orographical map, with layers in two colours and showing also trunk railways and Roman roads, the geological map, and the rainfall map are all clear and useful. The isotherm map would be improved by the omission of the mean annual isotherm, which is not only confusing when on the same map as the January and July ones, but of little or no value in geographical teaching. The map showing vegetation and productions is not a success. The large letters to indicate the location of various industries are crowded and somewhat arbitrarily selected. Thus Aberdeen is given no granite industry, while Ballater is; Leeds has no indication of its leather factories, or Elgin of its distilling and brewing. The West Riding coalfield extends much further east than shown. In the population map the many colours employed give a bad impression and make a confused map. The last map, that of communications, might well have been omitted. It shows some of the lines of the various railway companies all differentiated from one another. There seems to be little object in teaching the ownership of each line, but the great objection to the map is the want of any indication of relief. Without this there is no sense in teaching lines of communication. Moreover, the orographical map does all that is required in this matter.

All the maps have the same names printed in ground colour for the use of the teachers. It is useful to have the series all on the same scale, but we are at a loss to understand why this particular scale should have been selected. It does not facilitate comparison with maps on other scales.

Météorologie du Brésil. By C. M. Delgado de Carvalho. Pp. xix+527. (London: John Bale, Sons, and Danielsson, Ltd., 1917.) Price 25*s*. net.

THE publication of this work is very welcome, not only to meteorologists, but also to those having interests in this progressive Republic. Few except those who have had occasion to deal with South American meteorological observations can appreciate the onerous nature of the task which the author set himself in the preparation of this comprehensive climatology of his native country. In most cases the difficulties have been successfully surmounted, with the result that we have put before us in a very readable and instructive form a series of pictures showing not only the diverse character of the climates of Brazil, but also the interconnection that exists between climatic conditions and migration, immigration, and public health. The work opens with a summary of the broad climatic features, and of the local and general conditions affecting them. An interesting section deals with the "action centres" of the atmosphere, and of the genesis of the tropical rains. Nearly two-thirds of the book are devoted to an analysis of climatological data, this section including no fewer than thirty-four separate studies of local climate, the stations selected ranging from Para, near the equator, to Pelotus, in lat. 32° S. In some areas, such as the State of San Paulo, where stations are numerous, much additional information is given, especially regarding the diurnal range of the climatic elements. The unique position which Brazil occupies for a study of various meteoro-

logical problems of the first importance is pointed out by Sir Napier Shaw in the preface, and we trust that the wished-for extension of stations into wide areas not yet represented in the *Réseau Mondial* will materialise before long.

The work concludes with an excellent bibliography of the 160 memoirs consulted by the author. There are numerous illustrations, including plates showing the seasonal isotherms, and isopleths for four typical stations. This book will remain a standard work of reference on Brazilian meteorology for many years to come. R. C. M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Radiation of the Stars.

THE law $T \propto M^{\frac{1}{12}}\rho^{\frac{1}{6}}$ given by Prof. Eddington in NATURE of June 14 is so neat that one feels reluctance to cast any doubt on it, but since it is notoriously difficult to destroy a scientific error which has once obtained a fair start, I feel that whatever is to be said against the law ought to be said now.

The law is derived from Prof. Eddington's supposed equation, radiation-pressure=gravity. It must first be noticed that the two sides of this equation are of different physical dimensions ($ML^{-1}T^{-2}$ and LT^{-2} respectively), so that neither the arguments on which the equation is based nor the laws derived from it can carry much conviction. If p_G and p_R denote gas-pressure and radiation-pressure, the true equation of equilibrium is

$$\frac{\partial}{\partial r}(p_G+p_R)=-\rho g,$$

g being gravity, and when p_G is neglected in comparison with p_R, g does not become equal to p_R, but to $-\frac{1}{\rho}\frac{\partial p_R}{\partial r}$.

It is true that in his original paper on this subject (*M.N.*, November, 1916) Prof. Eddington obtains a relation of the form $p_R=Rg$, where R is a constant, but this equation is not based on the physical conceptions put forward in the article in NATURE. The outward flow of radiation from a star of radius r and effective temperature T is, of course, $4\pi r^2\times\sigma T^4$. Where does the energy of this radiation come from? Prof. Eddington assumes that it is a transformation of radio-active energy, initially emitted at a uniform rate $4\pi\epsilon$ per unit mass throughout the whole star. The star is assumed to be in a steady state, so that the rate of generation of energy, $4\pi M\epsilon$, is equal to the rate of emission $4\pi r^2\sigma T^4$, whence $\sigma T^4=M\epsilon/r^2$.

This equation is of the form $p_R=Rg$, and on eliminating r by means of the relation $M=\frac{4}{3}\pi\rho r^3$, we find that $T\propto M^{\frac{1}{12}}\rho^{\frac{1}{6}}$. (Prof. Eddington's complicated analysis, boiled down to its essentials, comes merely to this.) But it now appears that the supposed law is not, as might be thought from a casual reading of the article in NATURE, a deduction from already known laws of Nature; it is a transformation of the very special assumptions that all stellar matter is equally and uniformly radio-active, and that this radio-activity is the origin of all the energy radiated from a star.

The second supposed law, that the total emission of radiation from a star depends only on its mass, is a still more thinly veiled repetition of the same assumptions. The radiation is *assumed* to be $4\pi M\epsilon$, and ϵ is assumed to be a universal constant. When these assumptions have been made, it is scarcely worth announcing as a new law that the radiation depends only on M.

I venture to think that few physicists will be ready to accept these assumptions; in any case it is important that they should be clearly stated. It may be remarked that if the assumptions are true for giant stars they might be expected to be equally true for dwarf; they lead, however, to the laws given by Prof. Eddington, such as that of absolute brightness depending only on mass, which are palpably untrue for dwarf stars. J. H. JEANS.

London, June 16.

MR. JEANS's criticism of the dimensions of my equation, "radiation-pressure=gravity," is clearly only a verbal matter. It may be preferable to expand the sentence so as to read, "force on material due to radiation-pressure=force on material due to gravity." But statements that radiation-pressure is x times gravity have been commonly made in connection with the theory of the repulsion of comets' tails, and I thought the reader would have no difficulty in interpreting my statement in the same sense.

The rest of Mr. Jeans's letter is based on a misconception. He states that I assume ϵ (the rate of liberation of energy per unit mass) to be a universal constant; that is not the case, and consequently his account of the mode in which my principal results arise is erroneous. My results are not "a transformation of the very special assumptions that all stellar matter is equally and uniformly radioactive. . . ."

I should be glad to take the opportunity of correcting a misprint in the article: p. 309, col. 2, l. 18 from bottom, *for* $M\rho^{\frac{2}{3}}$ *read* $M^{\frac{1}{3}}\rho^{\frac{2}{3}}$. A. S. EDDINGTON.

Cambridge, June 19.

Protection from Glare.

EFFICIENT protection of the eyes from glare is a subject of considerable importance at the present time, but unfortunately a great deal of misconception has arisen in regard to it. Most glare protectors are designed for conditions of unusually strong illumination; generally speaking, for daylight. Many industrial operations also demand the use of light filters. We will deal first with the problem of protection in sunlight.

A great deal of experimental work has been done recently on the physiological effects of ultra-violet radiation in the eye, a quartz-mercury lamp being used as a source, which is especially rich in its emission of the shorter wave-lengths. The results, unquestionable and undoubted, are that with long-continued exposure serious harm may result from the absorption of these shorter waves by the refracting media of the eye, but with low intensities of radiation regular exposures produce no permanent effect. Turning now to the effects of daylight on the eyes, we recognise that few cases occur in which the symptoms point directly to the influence of ultra-violet light as distinct from the effects of ordinary strong illumination; but the problem of nerve strain arising from glare is ever present.

Quite low intensities of light will produce glare

when the eye is unadapted. The light from a gas lamp, blinding to an eye accustomed to darkness, appears feeble when viewed in full sunlight; yet its intensity of ultra-violet radiation is unchanged. Snow blindness may be caused on dull days, presumably owing to the inability of the upper part of the retina to adapt itself to the unaccustomed light from the ground. Dr. E. K. Martin[1] could detect no absorption by the refracting media of the eye in the visible spectrum, but he found that in the ultra-violet absorption begins at about 0·38 μ, and becomes complete for 0·35 μ and shorter wave-lengths. As the solar spectrum stops short at 0·29 μ (owing to the absorption of the atmosphere), we see that there is a short region from 0·35 μ to 0·29 μ, which may be absorbed and produce some physiological action. Therefore in cases where considerable sunlight or skylight must enter the eye, it is a good precaution to use a filter which will stop these ultra-violet rays, but at the same time it must be remembered that the main symptoms known as glare are not due to ultra-violet light at all, but simply to an illumination too intense for an unadapted retina.

To the normal eye the maximum luminosity in the solar spectrum lies in the region near the yellow. A great many filters now being supplied for anti-glare purposes are of a yellowish colour. They transmit 80 per cent. or so of the red, yellow, and green, and absorb the violet and ultra-violet fairly completely. It would seem at first sight as if such filters were very desirable to eliminate possibly harmful rays, and to reduce slightly the brightness of transmitted light. On using the screen, however, the apparent brightness of most objects seems to be increased, and glare is as evident as before. The phenomenon of adaptation is not yet fully understood, but we may refer in this connection to the work of Broca and Sulzer,[2] who found, in measuring the growth of visual sensation with time, and using various colours, that in every case there is an overshooting of sensation beyond its final value. With blue light the maximum sensation is at least five times, and with white light twice, the final value. If, then, the removal of the shorter wave-lengths interferes with adaptation, the apparent increase of brightness when using a yellow filter is explained. Obviously as an anti-glare glass the screen is worse than useless. This does not apply to the greenish glasses which actually reduce the apparent luminosity. In passing, it may be noted that a coloured filter of this nature is often useful for increasing contrast, eliminating blue light from haze, and increasing visual acuity. 'Amber' and 'red' filters are sometimes used. These generally absorb the green and blue parts of the spectrum, transmission again beginning in the violet. If fairly deep in colour they effectually stop glare, and may be exceedingly useful for special contrast work.

Neutral-tinted glasses have a comparatively uniform transmission over the whole spectrum. The use of such filters in practice immediately reduces any glare, and a proper balance of adaptation is established. It is curious to note in this connection that many of these neutral-tinted glasses, when about 1 mm. thick, transmit the ultra-violet from 0·39 μ to 0·32 μ almost as well as ordinary glass. They have often a slight increase of transmission in the green, and in the extreme red and infra-red they again show little absorption beyond that expected from glass of equivalent thickness. Light transmitted by a bundle of such glasses is found to consist of the extreme red, a little green, and the extreme violet; the sky, viewed through the bundle, appears of a deep purple colour.

Intense infra-red radiation also seems to produce well-marked effects on the eyes when exposure is regular and long-continued, but here again the amount ordinarily received by an eye exposed to daylight appears to be incapable of causing harm. It is uncertain how much (if any) of the discomfort of glare from the ground experienced in bright sunshine is due to the action of these rays. A correspondent of Sir W. Crookes describes the effect produced by spectacles of a glass containing ferrous iron, and absorbing the infra-red, as producing a marked cooling effect on the vision. This sensation may, of course, be merely the result of the relief from glare which the blue-green tint of the glass would secure. Manifestly, however, in circumstances where it may be necessary to look directly at or near the sun, an efficient filter is desirable to reduce intensity in all parts of the spectrum.

Some glasses show marked absorption in the infra-red in the neighbourhood of 1μ, notably those containing ferrous iron, cupric oxide, or ferric iron and cobalt together; these are blue to blue-green in colour. Interesting substitutes are metallic films on glass, suitably protected, which, for the most trying conditions, should make ideal glare glasses. As most of the radiation would be reflected, the glasses would tend to keep cool.

The problems arising in industrial work are relatively simple. For dealing with arc lamps, and sources extremely rich in ultra-violet light, dark green or brown-green glasses will be most suitable. For welding operations efficient protection from ultra-violet, visible light, and infra-red is important, as in this case it is necessary to watch the source of light intently. It is important also to select a filter which will not greatly distort the colour of the emitted light, as temperatures are judged in this way. A fairly dark neutral glass of good thickness will generally answer all practical purposes, but a highly efficient protector could be made by depositing a silver film of suitable thickness on a plate of heavy lead glass. This would be, as previously suggested, very effective in reflecting the heat rays, but the film would have to be protected.

A gold film can be made to transmit green light while reflecting almost all other radiations. Spectacles of this nature could be used with great advantage if it were necessary to work close to molten metal, or in many other circumstances.

It is hoped that this short summary of the subject may be of use to those dealing with problems in this connection. An extended series of tests on certain filters has been made by the present writer, and the results are now in course of publication in the Proceedings of the Optical Society. Filters for various purposes can thus be chosen, but their most important test will be their efficiency in actual use.

L. C. MARTIN.

[1] Proc. Roy. Soc., B., lxxxv., p. 319.
[2] *Compt. rend.*, cxxxvii., 1903.

Electric Discharge from Scythe.

IN reference to Mr. Pannell's observations recorded in NATURE of June 21 (p. 324), Mr. William Wilson more than a hundred years ago discovered that when dry wood is chipped with a knife the chips and knife become oppositely electrified.

There is no need of darkness to test the phenomenon in the case of dry grass cutting with the scythe. An ordinary gold-leaf electroscope held in the mower's hand, and having a wire attachment with the metal of the scythe, would scarcely fail to give indications if the electrification is actually sufficient to produce disruptive discharges. CHARLES E. BENHAM.

Colchester, June 23.

THE FUTURE OF EDUCATION.

SIR NAPIER SHAW has done good service to the cause of education by the timely publication of his trenchant "Open Letter" and other essays,[1] and although the brochure is a small one, its intrinsic value is not to be measured by the exiguity of its pages. The author writes with first-hand knowledge, gained partly in earlier years at Cambridge, and partly in the course of his experience as head of the Meteorological Office. In the latter capacity he is naturally brought into contact not only with newly finished products of the university mill who are seeking employment, but with men of affairs to whom the science of common life ought to be as generally familiar as, actually, it is not.

Thoughtful persons who happen to be conversant with the anomalies and anachronisms so obvious in the educational systems of this country will find themselves, although not perhaps in complete agreement, at any rate in sympathy with much that is so admirably set forth in this little volume. Of course, some effective shots are fired at the universities in which compulsory classics are still so strongly entrenched. The defenders of a position rapidly becoming hopeless might perhaps have been expected long ago to have recognised the common sense of the shrewd old poet who laughed at their prototypes in his own days:—

. . . nisi quæ terris semota suisque
Temporibus defuncta videt, fastidit et odit.

Perhaps in their hearts they may have done so, but custom and vested interests have always proved serious obstacles in the way of progress. Things are changing now, but whilst we want to destroy the loaded dice which have enabled the classical side of the great schools unfairly to win a wholly undue proportion of the ablest boys, we do not desire to see the aggrandisement of the modern side effected by the establishment of countervailing malpractices of a similar kind.

As soon, however, as we attempt to arrive at any conclusion as to what part science is to play in the education of the future, we encounter a distracting diversity of opinion. The war has brought many things home to us, and few things more forcibly than a recognition of the immense importance of science to the national safety. But on what lines are we going to move in the future? Sir Napier has pungent things to say about much of the stuff that passes for science in too many of our schools and colleges. He makes a strong appeal, based on utilitarian as well as on educational grounds, for the more adequate recognition of the "observational sciences." Those who have had to do with ordinary boys and girls are likely to agree with him in the main, and, as a matter of fact, beginnings have been already made in more than one of our great schools. The results have shown how well suited for young people a properly devised course of education on these lines can be made.

[1] "The Lack of Science in Modern Education, with Some Hints of What Might Be." By Sir Napier Shaw. Pp. 42. (London: Lamley and Co., 1916.) Price 1s. net.

A deplorable ignorance of the common, though fundamental, facts of Nature is by no means so rare as it ought to be amongst those who have acquired their knowledge of science in the laboratory. Perhaps this need not excite surprise, for even in high quarters we find curricula in science recommended which, although admirably adapted to enable a boy to win a scholarship under the existing defective methods of selection, are assuredly not calculated to stimulate his interest in the big experimental laboratory of Nature.

A distinguished professor has urged, in a recently published book, that the ideal school curriculum in science should begin with mathematics, to be followed by physics, chemistry, and mechanics, "and that wholly subordinate importance should be attached to the biological sciences, because [*sic*] the elementary stages of these latter subjects, necessarily largely descriptive, are insusceptible to broad treatment as illustrative of scientific reasoning and method." Perhaps it would not be easy to find a more complete lack of appreciation of the psychology of the ordinary boy and girl, or a more profound misapprehension of the relative values of the various branches of natural knowledge in earlier school education compressed into fewer words. A moderate amount of the physical sciences (particularly such parts as do not demand a broad treatment illustrative of scientific reasoning and method) is certainly desirable. What is, however, most needed for the average boy or girl is a training in accurate observation and elementary analysis of natural phenomena, not the formal science of the laboratory—that should come later—but in the field, on the hillside, in the cloud, and in the river. The good teacher will see to it that scientific reasoning will inevitably develop in the minds of the children. They will, and practice shows they do, become interested in common branches of natural knowledge, the very existence of which escapes so many grown-up people who were not shown how to observe these things when they themselves were young.

There is just as much danger of falling into a groove in the teaching of science as in that of other subjects, and it behoves all who have the interests of higher as well as school education at heart to keep a sharp eye on the specialist fiend. Mathematics is not the only gateway to science, any more than Greek grammar is the only avenue to the best literature. It takes all sorts of people to make a world, and it needs an acquaintance, elementary perhaps, but certainly not superficial, with all sorts of subjects to make an educated man or woman. It is the business of education to stimulate the development of all sides of the healthy mentality of boys and girls (whilst not neglecting their own natural bias) before the imperious needs of specialising in order to equip them for particular paths of life impose limitations on the area covered by instruction. Properly considered, if the foundations have been well and truly laid, and on a broad basis, it would seem that specialised instruction may be justly likened to the rising edifice, and it should form

the natural and proper continuation of earlier work. But for young people, whether they are going to be scholars or scientific investigators, men of affairs or ordinary citizens, what is pre-eminently needed is an education on broad lines, not a sham education, warped by early specialisation, whether in the direction of physical science or in that of the dead languages.

Of course, it is easy to say these things, but, as Sir Napier Shaw reminds us in an effective piece of criticism, we are up against many difficulties, amongst which there loom largely the systems of examinations and all that these imply. Like Frankenstein's monster, they have developed unexpected powers of strangulation, and, as with some forms of arbitrary legislation, have strengthened the very abuses they were designed to destroy. Are, then, examinations bad in themselves, or are the evil results, of which so much is everywhere heard, incidental rather than essential? Some sort of test of ability and efficiency will always have to be imposed, and it seems to be a fact that those to whom examinations are anathema have hitherto failed to present a workable substitute.

We may admit that many of the evils alleged to flow from the examination system are real, and especially the desiccating influence it has too often exerted on the training of those selected as payable candidates to be forced for competition for scholarships and other still more valuable prizes of life. But the root of the mischief is not altogether simple; it ramifies in more than one direction. In the first place, the system itself naturally tends to become stereotyped. Instead of providing a suitable test of the progress of those who have extended their studies in varied lines, it is apt to unify direction and stifle initiative. It is so much more easy to arrange examinations for one type of curriculum, and that by no means necessarily the best. So examination becomes a department of administration, where hard cases make bad law; and by a natural process of development the examination tends to become, in fact, the "final cause" of education itself—a complete reversal of its true position.

But to attack a thing because abuses have grown up around it is not necessarily sound practice, and it certainly is not good logic. It is true that the attempts hitherto made to check the evil effects of the system have not been very successful. This is due partly to the complex multiplicity of the examinations themselves, partly to a defective conception of the function to be discharged, but partly also to insufficiently recognised defects in the examiners.

The call for a reduction in the number of the various tests for entrance to the universities and for professional courses is urgent. We hope to see some practical scheme put forward by the Committee on Science appointed by the late Government some months ago. The chief desideratum is a sufficiently elastic system which, while not throttling the individuality of the school and the teacher, will ensure that those who pass the test do possess attainments enough to qualify them to enter on the next stage of their academic or professional career. The growing practice of accepting examinations "in lieu" has already paved the way for the introduction of a more comprehensive scheme in which the principle might be embodied on a large scale.

It is not so easy to find remedies for defects arising from the personality of the examiner, nor is it perhaps likely that all would even admit the existence of these defects, much less the need for remedies. But that we are here face to face with a real difficulty must, in fact, be perfectly well known to all who have had wide experience in these matters. Some of the evils, partly personal, partly dependent on administration, are more glaring than others. For example, in scholarship examinations it often happens that the successful candidate is selected without undergoing any oral test at all. Sometimes this is entirely the fault of those responsible for the general arrangements; sometimes the examiner avoids any real contact with the examinees. While such a practice may be defended in the case of a pass test, it ought never to be allowed when evidence of genuine ability constitutes the principal criterion for deciding between the competitors. A good examiner will easily appraise the value of written work in the course of a conversational oral examination. If he cannot, or if he only succeeds in scaring a candidate, he is not fit to discharge the duties of an examiner, however eminent he may be in other directions. Thus it would appear that it is with the system and with the examiner that the quarrel of the reformer really lies, rather than with examination *per se*. Don Quixote is not the only man who has wasted energy in tilting at windmills owing, let us say, to a lack of sense of proportion and of clear vision.

Amongst the expedients devised for obviating the deficiencies of badly conducted examinations, that of inspection has perhaps turned out to be the best. But the personal qualities and qualifications of the inspectorate are even more important here than they are in the examiner. A bad official can do immense harm, whilst, on the other hand, a capable one is of great value, inasmuch as the inspector exerts so powerful an influence for good or evil on the teaching.

But, whatever their faults, the inspectorate and the examination systems have a great mass of good results to be placed to their credit, and they do tend to weed out at least some types of incompetent teachers. Everyone who has had experience of schools is perfectly well aware of the real reason why the pupils at one centre are almost uniformly bad, while in another they appear to be almost as uniformly good. The difference, clearly, is not inherent in the children. Furthermore, it is quite intelligible, from their own point of view, why more than a thousand private and preparatory schools continue to refuse all inspection: the curious thing is that such unregulated experiments on the minds of children should be tolerated at all by the public of a country which claims to be enlightened. Perhaps it is because

the sheer business aspect of the matter has been hitherto insufficiently apprehended.

Many people will probably hesitate to follow the author in his proposals for an Educational Authority, and especially in the suggestion that it should be a committee formed, not by the Board of Education, but within the Privy Council. It would be interesting to observe the attitude of the Nonconformists if the Archbishops were alone to represent the educational policy for theologians; and, indeed, even in science the President of the Royal Society would probably find it beyond even his powers to represent so vast a series of subjects.

What seems to be really wanted is perhaps not so very remote, after all; from the essential elements of the proposed scheme. The general lines of educational policy will have to be laid down by people who are in contact with both education and affairs, and the means for giving effect to such policy will have to be provided. The carrying out of the policy, when the general plan is settled, will have to be left to the teachers, who ought not to be hampered in working out the details according to individual predilection. No doubt, a considerable overhauling of vested interests will be called for, abuses will have to be checked, and care will have to be taken that a proper balance is preserved between educational efficiency and the tendency towards early and excessive specialisation, whether at the school or at the university.

The danger of undue specialisation is a real one, especially among a people which, like ourselves, prides itself on being practical. It must not be forgotten that it is, and will continue to be, the business of schools, as well as of the universities, to train citizens as well as specialists, and that, while some will become specialists, all ought to be good citizens. Intelligent citizenship implies an intelligent outlook on the conditions that make for, and are involved in, our national and corporate life, and it becomes the more urgent to consider carefully, among the wide range of subjects, what things are, and what things are not, of immediate value in securing the satisfaction of this paramount need. In our great schools it is a matter of common complaint that too much time has been devoted in the past, with astonishingly small apparent result, to a very limited section of the "humanities," too little—sometimes none at all—to the great organised mass of knowledge commonly called science. And yet it is to the advance of science that we owe not only almost all our material progress, but nearly all our modern outlook on life and on the great problems that life holds for each one of us. J. B. FARMER.

THE WORK OF THE MINISTRY OF MUNITIONS.

LITTLE more than two years ago a small party of men met together at 6 Whitehall Gardens, under the chairmanship of the present Prime Minister, to form a Munitions Department. In the words of Dr. Addison, the present Minister of Munitions, speaking in the House of Commons on June 28: "There was to be one aim and one aim only—to obtain the goods and make delivery of them to the Army." The story, if it is ever told, of the creation of an organisation which is responsible to-day for the employment of two million persons, and for keeping the products of their exertions up to a level which continually rises, will certainly be astonishing, possibly one of the most wonderful in the history of this country, for the Ministry presents, perhaps, the most remarkable aggregation of men and women of diverse qualifications and attainments that has ever been got together in this country or in the world. Men from every branch of commerce and industry are serving, men of science, lawyers, literary men, travellers, soldiers and sailors, many of them as volunteers. The story, when told, will be one of improvisations connected with many disappointments, manifold and unexpected difficulties, and endless expedients, resulting in the creation of an organisation which, assuming, or having forced upon it, first this function and then that, became at last as prodigious in its proportions as in its output of munitions, and now constitutes an imperishable monument to British genius and resource.

On June 28, however, Dr. Addison reviewed the work of the various departments of the Ministry in plain and moderate language. He dealt with those which are concerned with the production of completed ammunition and the guns which use it, then with those which require the use either of steam or of internal-combustion engines, those which deal with the provision and working up of minerals and metals, certain common services, the trench warfare and other specialised departments, and those of labour and finance. A brief reference will be made to one or two of the most important activities of these departments.

Before the war this country was entirely dependent on Germany for its supplies of potash. This substance is required in both the agricultural and the glass industries. With regard to this Dr. Addison states: "Thanks to the ingenuity of Mr. Kenneth Chance and other gentlemen working with him, a process has been discovered whereby great quantities of potash may be obtained, and the development of the scheme is now in operation with the assistance of the Ministry. We shall be able to provide every ounce of potash that the glass trade requires, as well as very largely to meet the needs of agriculture."

Previous to the outbreak of war the output of steel in this country was about seven million tons per annum, and had remained almost stationary for some years. The output to-day is at the rate of nearly ten million tons, and a scheme is being worked out by which it is hoped to raise the production to twelve million tons by the end of 1918. The production of sulphuric acid has undergone great developments both in private works and in Government factories. A section of the Explosives Supply Department has been set up for the provision of all the artificial manures that are required, and the Ministry contemplates supplying at least a million tons of superphosphate, half a

million tons of basic slag, and a quarter of a million tons of ammonium sulphate. The capacity for the production of high explosive was in March, 1917, more than four times that of March, 1916, and twenty-eight times that of March, 1915.

DR. ROBERT BELL, F.R.S.

DR. ROBERT BELL, who died at Ottawa on June 19, was one of the pioneers in the geographical and geological exploration of Canada. Born at Toronto on June 3, 1841, he studied natural science and medicine at McGill and Edinburgh Universities, and graduated both as M.D. and as D.Sc at the former university. In 1857 he joined the Geological Survey of Canada, of which he became assistant director and eventually acting director shortly before his retirement. In the early part of his career he was also for a short time (1863–68) professor of chemistry and geology in Queen's University, Kingston, Ont.

Dr. Bell's most important work was the exploration and mapping of both sides of Hudson Bay and the Straits, and of the rivers entering Hudson Bay from the south. He also conducted the first surveys of Great Slave Lake, Lake Nipigon, and several other inland waters. As a geologist he paid special attention to the oldest rocks of the Laurentian and Huronian periods, but also made valuable contributions to our knowledge of the Pleistocene glacial deposits of Canada. As a naturalist he was a keen and skilled observer in many directions, but was especially interested in matters concerning forestry. As a medical man his services were at the disposal of several expeditions. Most of his reports were published officially by the Canadian Geological Survey and bear witness to the thoroughness of his researches; while many papers on more general questions were contributed by him to various societies and journals.

Dr. Bell was one of the original fellows of the Royal Society of Canada, and was elected a fellow of the Royal Society of London in 1897. He received the honorary degree of Sc.D. from the University of Cambridge, and in 1906 he was awarded the Patron's medal by the Royal Geographical Society. In 1906 he also received the Cullum gold medal from the American Geographical Society.

NOTES.

THE *Times* correspondent reports the discovery of the skeleton of a mammoth, in association with flint implements, in the neighbourhood of Bapaume, within the lines of the British Army in France. We understand that the British Commander-in-Chief has communicated the fact to the French Government, and that steps have been taken to preserve the specimen until the line of battle is sufficiently far removed to allow of careful excavations being made. The deposit in which the skeleton occurs has already yielded fragmentary remains of the mammoth.

IN reply to a question about the suspension of the publication of the *Kew Bulletin,* asked by Sir W. Byles in the House of Commons on June 26, Mr. Prothero said that the matter was now being reconsidered by the Publications Committee at the request of the Board of Agriculture. He hoped it might prove possible to resume publication.

WE regret to see the announcement of the death at Brussels, in his fifty-third year, of Prof. H. Van Laer, professor of chemistry at Mons, and president of the Chemical Society of Belgium.

NEWS has just reached this country of the death on June 2, at Pusa, Bihar, of Prof. J. H. Barnes, Agricultural Chemist to the Government of India, and late principal of the Government College of Agriculture, Lyallpur, Punjab; and also of Prof. E. G. Hill, principal of Muir College, University of Allahabad.

LIEUT. J. B. JONES, whose death in action on May 31, at twenty-six years of age, is announced, was educated at the University College of Wales, Aberystwyth, and was a B.Sc. in chemistry, physics, mathematics, and geology; he was student-assistant in geology at the above college, and had assisted in the Geological and Soil Survey of West Wales.

ANNOUNCEMENT is made in the *Times* that the Government has been reluctantly forced to the conclusion that it will be impossible to pass a Bill establishing a Ministry of Health during the present session of Parliament. It is possible that the measure may be introduced in the House of Lords, and certain steps taken which will facilitate its progress next session.

THE list of pensions granted during the year ended March 31 last, and payable under the provisions of the Civil List Act, 1910, includes the following:—Mrs. Charlton Bastian, in consideration of the services to science of her late husband, Dr. Charlton Bastian, and of her straitened circumstances, 100*l.*; Mrs. Minchin, in consideration of the scientific work of her late husband, Prof. E. A. Minchin, and of her straitened circumstances, 75*l.*; Mrs. Albert Günther, in consideration of the scientific work of her late husband, Dr. Albert Günther, and of his distinguished services to the British Museum as keeper of zoology, 70*l.*; and Mrs. Roland Trimen, in consideration of the eminent services of her late husband to biological science, and of her straitened circumstances, 75*l.*

BY the death of Sir George Birdwood, on June 28, at the age of eighty-four, the Anglo-Indian services have lost a notable personality. He joined the Indian Medical Service in 1854, and after taking part in the expedition to the Persian Gulf, he was appointed to a professorship in the Grant Medical College at Bombay, which was destined to be the scene of his Indian official life. He cultivated friendly relations with all classes of natives, and contributed to the *Times of India.* Finally, after serving as Sheriff of Bombay, his health broke down, and he left India in 1868, never to return. His administrative ability and fine taste in Indian art secured him a post at the India Office, where he was occupied in organising several exhibitions in which Oriental arts and crafts took a prominent place. For these services he was rewarded with a knighthood and the order of K.C.I.E. His scientific reputation rests on his work on the flora of Bombay, and his researches into the varieties of Boswellia and other sources of Oriental gums and resins. He left few contributions to literature of permanent value, but he was a clever journalist, able to discuss many subjects with wit and vivacity, though his views

on history, linguistics, and ethnology were often lacking in the learning of the true scholar. Some of his less ephemeral work was published about two years ago, under the title of "Sva" ("Myself"). His services to the Empire in promoting kindly relations between the European and the natives of India are his best monument.

THE eleventh annual report of the British Science Guild, together with the account of the proceedings at the annual meeting on April 30, has now been published in booklet form. In addition to particulars of the work of the Guild during the past year, the report contains a summary of progress in regard to the promotion of scientific and industrial research, and a series of appendices refers, among other matters, to "The Metric System and the Textile Industries," "Endowment of Education and Research," and "National Instruction in Technical Optics." The report of the eleventh annual meeting of the Guild includes the addresses by Lord Sydenham on national reconstruction, the Rt. Hon. H. A. L. Fisher on science in education and industry, and Mr. H. G. Wells on science in the curricula of our schools and universities. Lord Sydenham makes a number of stimulating suggestions in regard to the reform of education and the development of the material resources of the Empire with the view of solving the many crucial problems that may be expected to arise after the war; Mr. Fisher points out that education in scientific knowledge and method need not be divorced from the study of "humanistic" subjects; while Mr. Wells pleads for the removal of the barriers set up against the latter studies by insistence on the acquirement of such knowledge solely through the medium of the Greek and Latin languages. The booklet is obtainable from the offices of the Guild, 199 Piccadilly, W.1, at the price of 1s.

NOTWITHSTANDING the great loss of life caused by the explosion at Ashton-under-Lyne on June 13, the area over which the sound was heard was remarkably small. All the recorded observations lie within a continuous area, extending chiefly in the north-north-west direction to the village of Church, near Accrington, distant twenty-one miles from Ashton. In the opposite direction, the sound-area is not well defined, but the boundary probably passes about six miles from the source of sound. There is no evidence of the observation of multiple reports, the sound at all places more than a few miles from Ashton being a single boom. The shaking of windows immediately after the report points to the existence of long-period air-waves travelling with a velocity slightly less than that of the sound-waves. Though the number of British explosions which have been investigated is small, it is worth noticing that those with double sound-areas occurred during the winter months (namely, Spithead minute-guns on February 1, 1901; Hayle explosion on January 5, 1904; and East London explosion on January 19, 1917), and those with single sound-areas during the summer months (namely, Spithead reviews on July 17, 1887, and June 26, 1897; St. Helens explosion on May 12, 1897, and Ashton-under-Lyne explosion on June 13, 1917). In Japan, according to Prof. Omori, nine out of eleven recent Asama-yama explosions with double sound-areas occurred in the winter, while ten out of eleven explosions with single sound-areas occurred in the summer months.

IN the *Revue Scientifique* for June 9 Prof. Jean Massart advocates the formation of "Une Organisation Scientifique Interalliée," in order to facilitate the exchange of books, students, and men of science amongst the Allied countries, for the publication of *résumés* of scientific work, and for the establishment of scientific institutes. For some years international scientific exchanges have arranged the dispatch of scientific publications from one country to its neighbours post free. It is suggested that this system should be extended so as to permit the free transport of all scientific publications which have no commercial character. Many countries provide travelling scholarships for students who have completed a course of study, but if the annual programmes of work in all universities were equalised it would be possible for a student to take part of his degree course in one country and another part in an Allied country. Prof. Massart also advocates the exchange not only of professors (an example which America has set), but also of librarians, keepers of museums, astronomers, doctors and surgeons of large hospitals, etc Finally, the creation of purely scientific institutes by the co-ordinate action of the Allies is recommended. These research institutes should be independent of teaching, and would be attached to neither schools nor museums. For many sciences the precise situation of the research centre would be immaterial. For such sciences as botany, zoology, meteorology, etc., separate institutes would be required in each of the large climatic and geographical zones of the earth. Thus for biology there might be an Arctic Institute in the north of Russia, equatorial institutes in Ceylon, the Congo, and Brazil, and so on. The strengthening of commercial, industrial, and political relations between the Allies is being urged upon us; as the author says, it is not less important to exchange "ideas and men."

SIR HENRY TRUEMAN WOOD will retire in September next from the post of secretary of the Royal Society of Arts, which he has held since 1879, having previously been editor of the Journal and assistant secretary. He will be succeeded by Mr. G. K. Menzies, who has been assistant secretary of the society since 1908. The council has decided to institute an annual lecture dealing with the application of science to industry in order to commemorate Sir Henry Wood's long association with the society. The Albert medal of the society for the current year has been awarded to Orville Wright, "in recognition of the value of the contributions of Wilbur and Orville Wright to the solution of the problem of mechanical flight." Referring to this award, the report of the council says:—"In 1896 the Wrights began to experiment with gliding machines, continuing the work of Lilienthal and Pilcher, which had been cut short by their deaths. Having obtained considerable success with 'gliders'—for Orville Wright on one occasion succeeded in making a soaring flight of ten minutes—in 1903 they fitted an engine and propeller to their machine, and with this apparatus they were able to make short flights. Inasmuch as this was the first apparatus in which a man was carried in the air by mechanical power, though Langley and others had previously made small mechanical flying machines, it may fairly be considered the first aeroplane in the present acceptation of the word. The machine was patented in 1907. The validity of the patent has never been confirmed by any legal decision, but practically the British Government admitted its validity by a payment to the inventors in 1914 of 15,000*l*. After the initial difficulties had been overcome by the patient labours of the Wrights, the machine developed rapidly. It may be true that in the present aeroplane not much is left of the machine described in the 1907 patent, but the changes, apart from the improvements in the engine on which the modern aeroplane mainly depends for its success, have all been legitimate developments of

the ideas of the original inventors, and in no way detract from their credit. It remains, therefore, certain that, whatever value may attach to the contributions of others, the largest share in the honour of having invented the aeroplane must always be given to the two brothers, Wilbur and Orville Wright."

MR. E. SIDNEY HARTLAND, president of the Bristol and Gloucestershire Archæological Society, devoted his annual address, published in vol. xxxix. of the society's Transactions, to a discussion of the legend of St. Kenelm, the boy-saint, whose shrine at the ancient Abbey of Winchcombe, in a beautiful little dale at the foot of the Cotswold Hills, was a famous place of pilgrimage until the Reformation. To-day not one stone upon another of this great religious building remains. The abbey was founded about the end of the first decade of the ninth century by Kenwulf, king of the Mercians and father of the honoured saint, whose remains were probably interred there. But, as is the case with many elaborate legends of this kind, the story of his life fails to stand the detailed historical criticism which Mr. Hartland has devoted to it. The paper, which is very interesting, may be regarded as a study of the value, for historical purposes, of local tradition, and will be valuable both to the antiquary and to the student of folklore.

MUCH progress has been made during the last century in the scientific treatment of the geography of Ptolemy. But the standard edition by C. Mueller, continued by C. Th. Fischer, is still incomplete, and the condition of the MSS. offers an opportunity for much useful work. In a paper contributed to vol. xxxvii., part i., of the Journal of Hellenic Studies for 1917, Mr. L. O. T. Tudeer examines the maps attached to various MSS., especially that known as the "Codex Constantinopolitanus Chartaceus," which has been assigned to the fourteenth or fifteenth century. At first sight the maps of this MS. give a pleasing impression, but more careful examination discloses various difficulties and discrepancies which it is not easy to explain. Either a copyist has first copied the maps without writing down the names from his authority, and after finishing his work has added names from the text, not from his model, or else the maps did not originally belong to the text, but some draughtsman afterwards traced them, and he has not always been careful to avoid faults and inconsistencies. Mr. Tudeer's careful examination of the MS. material should prove to be of value in clearing up the many difficulties of this great early contribution to scientific geography.

IN the *Scientific Monthly* for June, 1917, vol. iv., No. 6, Dr. Jonathan Wright contributes an article entitled "Demonology and Bacteriology in Medicine." He begins with a survey of the beliefs of various savage races, which consider that all, or most, kinds of disease are due to the action of demons or malevolent spirits. This account would be more useful to the student if the writer had not adopted the careless method of quoting his authorities without precise references. He remarks that we may venture to assert that primitive men were right in supposing that "some external agent, demon or bacterium, introduced from without, is the cause of most disease. Indeed, in pointing out the conception of a conflict of the evil spirits of disease with the good spirits that defend the body within, we are perhaps within hailing distance of the time when Hippocrates defined disease as a conflict between opposing forces waged in the bodies of men and animals. It persists as the best definition of disease modern science can give, but the concept did not originate with Metchnikoff, nor even with Hippocrates. For, of the people of the Lower Niger, to whom neither Socratic nor Hippocratic wisdom seems to have penetrated, it is said that 'every medicine to be of any use must have within it a spiritual essence to defeat the operations of the aggressive invader.'"

AN admirable survey of the American warblers and their value to the agriculturist appears in the *National Geographic Magazine* (vol. xxxi., No. 4). The author, Mr. Henry Henshaw, described some thirty-six species of these birds, giving details of their nesting habits, distribution, and migration. His essay is supplemented by thirty-two exquisitely coloured figures, drawn by Louis Fuertes, the finest bird artist America has yet produced. His work, indeed, compares favourably with that of the best European artists—and they are very limited in number.

THE great snowstorm which crossed Ireland from N.E. to S.W. during January of this year seems to have exterminated a number of resident species of birds throughout the area covered by the storm. A long account of the havoc wrought is given in the *Irish Naturalist* for June by Mr. C. B. Moffat. The thrush was the first to succumb, then the blackbird, stone-chat, golden-crested wren, long-tailed titmouse, grey wagtail, and meadow-pipit. Scarcely any meadow-pipits survived, and the number of summer visitants to the islands seems to be far below the average. This will mean that very few young will be reared this year, since the meadow-pipit is the favourite dupe of the cuckoo, which will in consequence monopolise most of the nests of this bird to the exclusion of the rightful occupants.

PROF. G. H. F. NUTTALL, The Museums, Cambridge, is engaged in an investigation on human lice, and desires to obtain specimens and accurate information concerning these parasites from different parts of the world. The specimens should be killed and well preserved in 70 per cent. alcohol; about fifty adults, besides larvæ, if obtainable, are desired from each locality. Head-lice and body-lice should be kept apart. They should be accompanied by brief notes regarding their prevalence on the races or inhabitants of the region whence they are sent. Where specimens are not procurable, any written communication on the subject will be welcomed by Prof. Nuttall, and references to the mention of lice in works of travel may prove useful. Communications may be written in any European language, according to the convenience of the correspondent.

AN urgent plea for the establishment of a chair of economic ornithology at one of our universities is made by Mr. W. Berry in the *Scottish Naturalist* for June. By way of illustrating his arguments he gives analyses of the crop contents of a number of sparrows, wood-pigeons, and pheasants. While admitting, as all must, that the house-sparrow sadly needs thinning, he re-directs attention to the fact that these birds do assist in keeping down insect pests. Black game and pheasants are recommended, he remarks, by the Board of Agriculture for wholesale destruction, without distinction of district or topography. Yet an analysis of the crop contents of 183 pheasants made in 1893 disclosed the remains of more than 100,000 injurious beetles and other insects, larvæ, and slugs, while the total number of husks and fragments of corn of any kind was thirty-seven. In another case the crop contents of a single cock pheasant from Argyllshire yielded no fewer than 2286 specimens of Bibio, and 508 of the heather beetle, which plays so

prominent a part in the spread of grouse disease, besides tubers of the lesser celandine and fragments of leaves of many species of noxious weeds.

MR. R. J. TILLYARD, of the University of Sydney, has sent us a communication regarding the systematic position of Dunstania, a genus of Triassic insects, founded on a wing described by him in Publication 253 of the Queensland Geological Survey, which has attracted much interest among entomologists in these countries (see, *e.g.*, NATURE of September 28, 1916, p. 75). Mr. Tillyard referred the wing provisionally to a moth, but some of our homeland students have advocated that its affinities are with the Homoptera, or with the Psychodid Diptera, especially with the New Zealand genus Exsul. Close study of further material has now convinced Mr. Tillyard that Dunstania is a dipteron with affinities to Exsul, though he would not place the two genera in the same family, and regards them, not as Psychodids, but as primitive Muscoids. "If, then, I am right in my opinion," he says, "we have to face the remarkable possibility of the existence of muscoid types in Australia in the Trias. This would place the origin of the Diptera much further back in geologic time than has hitherto been deemed at all possible." In concluding his letter, Mr. Tillyard mentions the exceedingly interesting fact that he has "quite recently discovered two well-preserved Panorpid wings in the Permo-Carboniferous Coal Measures of Newcastle, New South Wales." The existence of Holometabolous insects in Palæozoic times may therefore be taken as established.

AN interesting paper on "Herb-growing in the British Empire: its Past, Present, and Future," is published in the Journal of the Royal Society of Arts (No. 3363, vol. lxv.), being a paper read by Mr. J. C. Shenstone on May 2. It is pointed out that the cultivated herbs have always driven the wild products from the market, and it is asserted, no doubt truly, that there is a considerable future for such an industry generally throughout the Empire. Ginger-growing in Jamaica and the clove industry in Zanzibar are both examples of successful enterprises, and it is suggested that gum-yielding acacias and gum Tragacanth, among other things, should be subjected to cultivation.

WE learn from the *Botanical Gazette* for May that the Botanical Station at Cinchona, in the Blue Mountains of Jamaica, has now been leased to the Smithsonian Institution on behalf of fourteen American botanists and botanical institutions that have contributed the rental. It will be remembered that an article on the Cinchona Gardens and Stations was published in NATURE of June 17, 1915, when an agreement was come to between the Jamaican Government and a committee of the British Association for the annual tenancy of the Cinchona Bungalow as a laboratory for botanical research in the tropics. Unfortunately the war has prevented the laboratory being used, as was hoped, by British botanists, but no doubt American botanists will not be slow to recognise the stimulus of such a station for botanical work. The station has already been in American hands, as it was held under lease by the New York Botanical Garden from 1903–13.

A TIMELY article on "Grassland and Ploughed Land," by Mr. R. G. Stapledon, adviser in agricultural botany, University College, Aberystwyth, is published as a supplement (No. 17) to the May issue of the *Journal of the Board of Agriculture*. The national need for a great increase in the home production of corn and potatoes renders inevitable the breaking-up of very large areas of grassland, and throws a correspondingly heavier burden upon such grass as remains, if our stocks of cattle and sheep are not to suffer a serious reduction. In his lucid summary Mr. Stapledon indicates the directions in which grassland can be improved and what is its real significance in a rational system of agriculture designed to secure a maximum production of food. The various types of grassland are characterised, and the appropriate lines of improvement of each type are indicated. Guidance is furnished as to the characteristics of the more desirable grasses and clovers, and suitable mixtures for different conditions are given.

MR. MARTIN H. F. SUTTON has carried out a careful series of experiments with "Humogen" in comparison with other fertilisers, and the results are published as a special bulletin (No. 8) by Messrs Sutton and Sons, Reading. The first series of experiments was carried out on dwarf French beans, potatoes, and red clover, and the supply of "Humogen," or bacterised peat, was obtained from Manchester, where it was being manufactured for Prof. Bottomley. The experiments proved failures, the plants treated with "Humogen," having a stunted and scorched appearance, while those with other fertilisers or farmyard manure grew vigorously. As some toxic or inhibiting factor seemed to be present in the Manchester "Humogen," a fresh and larger series of trials was made later in the year with "Humogen" prepared at Prof. Bottomley's laboratory at Greenford, and with Manchester "Humogen" supposed to be rectified. The results with the latter were as unsatisfactory as in the first series of experiments, but the Greenford "Humogen" gave far better results, and were second only in merit to those dressed with a complete fertiliser. The bulletin is illustrated with an excellent series of photographs.

WE learn from the *Geographical Review* (vol. iii., No. 5) that a strong movement is under way in the United States to develop a survey of the air over North America and adjoining waters. The objects are to observe and chart the irregularities of air currents, to establish aerological stations for observers, not only at the earth's surface, but also aloft to 10,000 ft. or more, and thereby to safeguard aircraft and the lives of aviators. The National Advisory Committee for Aeronautics is fostering the movement, and has the support of the Aero Club of America. The hope is expressed that this survey may in time be put on the same footing as the Hydrographic Survey, the Coast and Geodetic Survey, and the Geological Survey.

A WAR map of Palestine at the low price of 6*d*. has been published by Messrs. W. and A. K. Johnston. The map is in black and white, except for an outline of colour round the chief districts. Relief is shown by hachures, and is fairly successful as regards a general impression, but does not admit of analysis of any small area. There is an abundance of names without overcrowding, but some are difficult to read across the hachures. A list of the chief Arabic terms occurring in geographical names is added. The chief criticism of the map must be as regards the scale, for while the map itself has the extraordinary scale of 1 : 714,649 (11·279 miles to an inch), the inset of Lower Egypt has the scale of 1 : 2,800,000. These are serious blemishes, inasmuch as they prevent ready comparison.

AN interesting presidential address by Prof. W. H. Hobbs to the Michigan Academy of Science in March last on "The Making of Scientific Theories" is printed in *Science* for May 11. The object of this address is to show that "scientific theories, as they

are constructed even to-day, with the aid of all modern equipment and inheritance, may contain fatal elements of weakness, though they be promulgated by scientific men of the highest rank and attainments." Men of science are, of course, subject to the limitations of prejudice, undue reverence for authority, and so on, and also they and their critics often fail to distinguish clearly between legitimate theory within those fields where views may be rigidly tested and audacious conjecture. Prof. Hobbs then reviews by means of examples the position of science from the earliest times down to the memorable defeat of Bishop Wilberforce by Huxley in 1860. In the fifth century we read, what sounds like a pessimistic prophecy, that "with the invasions of the barbarian Huns and the Germanic tribes there ensued the eclipse of civilisation. . . ." In this sketch the attempts at the control of scientific theory by the Church were shown gradually to decline, although in this respect the Church was quite powerful even fairly lately. Prof. Hobbs then selects some examples from geology in order "to discuss what may perhaps be called the psychology of theories and the conditions which determine their acceptance": the effect of certain features of Mallet's theory of earthquakes in removing seismology from the field of geology for the period of nearly half a century, and giving it over to the elasticians; the mistaken deductions from the aerothermic and geothermic gradients; Ferrel's mistaken deduction of whirls about the geographic poles, and so on.

At a time when the supply of our food is controlled by men who probably know little of the science of nutrition, and nothing at all of physiological chemistry, the appearance (in the *Revue Scientifique* for June 9) of an article by Prof. E. Gley, entitled "Le Besoin d'Aliments Spéciaux," is particularly opportune. Probably the vast majority of people in this country think that if there is a shortage of any particular article of food it can, in all cases, be replaced by another without detriment to the health of the consumer. As Prof. Gley points out, however, of the four principal forms of nutritive material, mineral salts, carbohydrates, fats, and proteins, mineral salts will not replace, and cannot be replaced by, any of the others. Carbohydrates and fats, which supply energy, are to a certain extent interchangeable, but neither of them is a substitute for proteins, which in their turn will not replace either carbohydrates or fats. Further, vegetable proteins will not replace animal proteins. It has been shown by the researches of various workers that neither animals nor man will maintain their nitrogen balance or their body weight when their protein food consists of the zein of maize or of the globulin of lupins. Other proteins, *e.g.* the gliadin of wheat and the hordeine of barley, whilst sufficient to maintain bodily equilibrium, will not promote growth. These two phenomena have been proved to be due, the first to the absence of tryptophane from zein and globulin, the second to the absence of lysin from gliadin and hordeine. In order to maintain the nitrogen balance and to promote growth the protein nutriment of man must contain tryptophane and lysin. It is because meat contains all the necessary amino-acids, and contains them in suitable proportion, that it is so valuable as a food. For the efficient working of the digestive system cellulose is an indispensable constituent of food. Rabbits fed on rations containing no cellulose die of intestinal obstruction. The green vegetables ordinarily eaten with meat are valuable as supplying the necessary cellulose. Prof. Gley advocates the consumption of dried fruits for the same reason. These have the advantages over green vegetables that they contain more cellulose and can be obtained independently of the season.

Dr. J. S. Haldane submitted a paper to the recent meeting of the Institution of Mining Engineers upon "The Spontaneous Firing of Coal," in which he summarised the results of the researches carried on during the last four years at the Doncaster Coal Owners' Research Laboratory. Even apart from their purely technical importance, some of the results obtained form a valuable contribution to our knowledge of the physico-chemistry of coal. Thus it has been shown that coal, even in thin slices, is highly impervious to the passage of gas, so that changes of atmospheric pressure can have no appreciable influence on the evolution of gas by solid coal. On the other hand, it is found that coal has an extraordinarily high solvent power for gases, the ordinary atmospheric gases being far more soluble in coal than in water, and, further, the rate of solution of these gases follows Henry's law, just as though they were in solution in a liquid. In the case of oxygen some of the gas is thus dissolved or adsorbed, while some enters into chemical combination with certain of the constituents of the coal. The rationale of the oxidation of coal has been investigated, and the part played by pyrites in such oxidation has been determined, but more research is needed in order to settle the exact nature of the substances most readily attacked by oxygen and of the products of such oxidation.

The growing interest in special acid-resisting alloys and the many uses found for them has stimulated both the search for efficient materials of this nature and the study of the causes underlying their inertness. The alloys developed by Prof. S. W. Parr for use in calorimeter construction have shown this quality of high resistance to corrosion to a marked degree. The almost perfect insolubility of these alloys in nitric and other acids seems to be conditioned upon a proper mixture of chromium, copper, and nickel, together with smaller quantities of such added metals as tungsten and molybdenum. These additions have so marked an effect in improving both the acid-resisting and casting qualities of the alloys that it has seemed desirable to study their effects more systematically in order that they may be used to the best advantage. This study has been undertaken by McFarland and Harder, and the results of their preliminary investigation have been published in Bulletin No. 93, University of Illinois. The complexity of the mixtures used has made the problem difficult, and has shown the necessity for first obtaining a more complete knowledge of the ternary alloys of chromium, copper, and nickel, and also of the three binary systems underlying them. It is quite obvious from this preliminary study that much more work requires to be done to establish the copper-chromium and nickel-chromium equilibria on a satisfactory basis.

Engineering for June 29 contains an illustrated account of the new Cunard liner *Aurania*, which has just been put on the North Atlantic service. This vessel has extensive second- and third-class passenger accommodation, and has also large cargo holds. The dimensions are 538 ft. 6 in. long, 65 ft. 4 in. beam, and 46 ft. 6 in. depth. The gross tonnage is 13,936, and with geared turbines of approximately 7200 shaft-horse-power she will have a sea speed of fourteen knots when displacing 21,405 tons. The calculated coal consumption is only about four tons per hour, hence the propelling expense will be very favourable in view of the large earning power indicated by the passenger and cargo capacity. The vessel has been constructed under the Convention regulations by Messrs. Swan, Hunter, and Wigham Richardson, and the machinery by the Wallsend Slipway and Engineering Company.

THE Board of Agriculture and Fisheries announces the publication of a second edition of vol. iv. of the special reports on the mineral resources of Great Britain, which have been prepared by the director of the Geological Survey in response to numerous inquiries that have arisen through the conditions brought about by the war. In the main it is a reprint of the first edition, wherein the properties, sources, and uses of fluorspar, and details of all workings in Britain, active and inactive, are given.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following ephemeris for Greenwich midnight is given by Messrs. Crawford and Alter in Lick Observatory Bulletin No. 295. It is based upon revised elements, calculated from observations made by Barnard on 1916 April 24, 1916 December 31, and 1917 April 21:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
July 6	22 57 3	24 40 7	0·0496	
8	23 0 15	40 13	0·0461	2·48
10	3 21	38 31	0·0426	
12	6 19	34 58	0·0391	2·53
14	9 11	29 32	0·0357	
16	11 55	22 10	0·0324	2·57
18	14 32	12 50	0·0291	
20	17 1	24 1 30	0·0259	2 61
22	19 23	23 48 8	0·0228	
24	21 37	32 43	0·0198	2·64
26	23 43	23 15 13	0·0168	
28	25 41	22 55 39	0·0140	2·67
30	27 31	33 59	0·0114	
Aug. 1	23 29 14	22 10 13	0·0088	2·68

The unit of brightness is that on April 21, 1917, when the comet was observed by Barnard to be not brighter than 12th magnitude. It is quite improbable that the comet will become visible to the naked eye, as was at one time anticipated.

COMET 1917*a* (MELLISH).—Prof. E. Strömgren sends us the following communication from Copenhagen Observatory:—"Prof. S. S. Hough, director of the Cape Observatory, writes:—The discovery of a new naked-eye comet by Warren was announced to us by telephone on April 15. From observations made in this observatory on April 18, 20, and 22 the following elements of the orbit have been derived:—

$$\text{Elements:}\quad \begin{array}{l} T = 1917 \text{ April } 10{\cdot}8043 \\ \left.\begin{array}{l} \omega = 124^\circ\ 32{\cdot}6' \\ \Omega = 85^\circ\ 42{\cdot}9' \\ i = 32^\circ\ 6{\cdot}1' \end{array}\right\} \text{For equinox of date} \\ q = 0{\cdot}1975 \end{array}$$

"The comet is 1917*a* (Mellish)."

COMET 1917*b* (SCHAUMASSE).—The following continued ephemeris for this comet, by Messrs. Fayet and Schaumasse, is based upon elements calculated from observations made at the Nice Observatory:—

1917	R.A. h. m. s.	Decl. ° ′	Log Δ	Log *r*	Brightness
July 4	9 40 50	+10 55	0·2357	0·0691	0·3
8	42 51	9 59	0·2659	0·0885	0·2
12	44 46	9 8	0·2929	0·1073	0·2
16	46 35	8 22	0·3171	0·1255	0·1
20	48 21	7 40	0·3389	0·1431	0·1
24	50 3	7 0	0·3585	0·1601	0·1
28	9 51 45	+6 23	0·3762	0·1765	0·1

The ephemeris is for Greenwich midnight (*Journ. des Observateurs*, No. 18). The comet is now rapidly receding from the earth.

ROTATION IN PLANETARY NEBULÆ.—In continuation of their previous investigations (NATURE, vol. xcvii., p. 268), Prof. W. W. Campbell and Mr. W. H. Moore have announced that the planetary nebula N.G.C. 7662 shows rotational effects very definitely in its spectrum, and that the bright nebular lines are doubled in the parts corresponding to the central region of the nebula. The most satisfactory interpretation is considered to be that the lines are widened by the differential radial velocities in the central part of the nebula, and that an outer stratum of absorbing nebulosity, with a slower rotation, is responsible for an absorption line lying nearly centrally along each bright line (*Popular Astronomy*, vol. xxv., p. 313). The nebula N.G.C. 7026, the general outline of which is a relatively flat ellipse, is also rotating rapidly and the evidence is fairly conclusive that there is an outer equatorial zone of absorbing matter. A further example of high angular speed of rotation has been found in the nebula Jonckheere 320.

THE USE OF ZIRCONIA AS A REFRACTORY MATERIAL.

THE Transactions of the Ceramic Society, vol. xvi., part i., contain an interesting article by Mr. J. A. Audley on the above title. This substance, ZrO_2, occurs somewhat widely distributed, chiefly in the form of the mineral zircon, in which it is combined with silica. A more abundant source has recently been found in the mineral Baddeleyite, which contains from about 80 to 94, and even 98, per cent. of zirconia. This mineral was discovered in 1892 almost simultaneously by Hussak in southern Brazil and by L. Fletcher in Ceylon, the former deposit being much the more extensive and valuable. It also occurs in North America, Australia, and the Ural Mountains. Zirconia is also a by-product of monazite sands. Baddeleyite has a hardness of 6·5 and a specific gravity of 4·4 to 6. It is insoluble in acids, except hydrofluoric acid, but is easily attacked by fused potassium hydrogen sulphate. The melting point of raw zirconia is in the neighbourhood of 2000° C., that of the purified material being considerably higher. It can be both melted and volatilised in the electric furnace. It is a "neutral" substance of the same type as alumina and is said to have a high resistance to the fluxing action of both acid and basic slags. Its heat conductivity is remarkably low, and its coefficient of expansion on heating is nearly as low as that of quartz glass, both of which are very valuable properties. It resists the action of fused cyanides and alkalies.

Dr. J. A. Harker was one of the first in this country to direct attention to the valuable properties of zirconia, but the matter has only recently been taken up for investigation, and much more attention has been paid to it abroad, particularly in Germany, where numerous patents have been taken out. It was applied to the manufacture of muffles, retorts, and tubes by Pyfahl in 1904, and two years later by the Heraeus Company for crucibles in which quartz was to be fused. The suggestion has also been made to replace thoria or yttria as an inner coating for the iridium tube in the Heraeus iridium furnace.

As a lining for electric arc furnaces the natural product is good enough, its high melting point, low thermal conductivity, and small coefficient of expansion making it particularly suitable for this purpose. Now that it is obtainable at comparatively reasonable prices, it can be used for the manufacture of refractory bricks. The market price in Germany before the war varied from 31*l.* per metric ton for the crude mineral to 50*l.* for the 98 per cent. variety. It has been found that a zirconia-lined hearth of an open-hearth steel-making

furnace at Remscheid was still in good condition after four months' continuous working at high temperatures. Calculations based on the same tests showed in actual maintenance costs a saving of more than 50 per cent. in favour of zirconia as compared with the refractory lining ordinarily used. Ferro-zirconium, containing up to 35 per cent. zirconium, obtained by reducing a mixture of the oxides with aluminium, has been prepared and used as the basis of introduction of the metal into steel for armour-plates, armour-piercing projectiles, and bullet-proof steel.

Zirconia also finds application as an addition to melted quartz to prepare "siloxide glass," a product resembling quartz opaque glass, but harder, less fragile, more resistant to mechanical stresses and basic oxides (excepting alkalies), and less easily devitrified than quartz glass.

Recently Ruff and Lauschke have investigated the refractoriness and other properties of zirconia, alone, and mixed with certain other oxides.

HYDRO-GEOLOGY IN THE UNITED STATES.[1]

DIPPING into a bundle of recently issued reports of the United States Geological Survey, all exhibiting evidence of the scrupulous care and unwearied industry of those responsible for the collection of data relating to the water-bearing capacities of the several regions under observation, we extract from a considerable mass of information one or two items which seem to possess some general, as well as local, interest.

(1) The topography of certain parts of Arkansas and the adjoining States is characterised by numerous low, circular mounds, from 20 to 100 ft. in diameter, and from 1 to 4 ft. in height. It is stated that in certain districts they are present in astonishing numbers, many fields being completely covered with them. They occur indiscriminately among the unconsolidated clays, loams, marls, sands, and gravels in the lowlands, on the uplands of Cretaceous and Tertiary age, and on the slopes of Palæozoic hills. The materials of which they are composed are in some cases slightly coarser and lighter in colour than the surrounding soils, while in other cases the components are essentially similar in structure, composition, and colour. No satisfactory explanation has yet been put forward to account for these conformations. Springs and gas-vents, coastal dunes and ant-hills, wind action and human agency, have all been suggested as originating or contributory causes; but no single theory fits in convincingly with all the conditions and facts. They remain a standing puzzle to observers.

(2) The broad desert valleys of New Mexico, composed of gravel, sand, and clay, are designated "bolsons." Rising up at intervals from the level uniformity of their surfaces are narrow, rocky ridges, ranging in length from two to twenty miles, and in height from a few hundred to nearly 2500 ft. It is probable that all these ranges have an underground connection, forming in reality a single range. They represent a thick succession of sedimentary rocks of all ages, from Cambrian to Recent, overlying pre-Cambrian granite, which outcrops in some of the ridges. In places the depth of the bolson deposits runs to considerably more than 1000 ft.

(3) The chief water-bearing formations of Connecticut are the unconsolidated materials of Glacial origin which overlie the bedrock. There are two types—the unstratified and the stratified, the former a heterogeneous mixture of débris deposited directly by ice, and the latter the same ingredients, but reassorted and deposited by water. The Glacial drift is only thin, and the surface of the underlying rock rugged. This results largely in the localisation of much of the rainfall (amounting to 45 in. per annum), causing supplies, at times, to be deficient through periods of several weeks, or even months.

(4) One of the difficulties confronting settlers in the San Joaquin Valley, California, is the adverse influence on plant culture of the alkali salts in the soil. If the alkali content be in any degree excessive, growth is retarded, and possibly arrested altogether. The farmer has to control the accumulation of soluble salts near the surface of his land, if he is to obtain satisfactory results. A common practice is to flood the area with water, which dissolves the alkali salts and carries them down below the zone of influence on delicate rootlets; but this method is only partially effective, unless measures are taken to prevent surface evaporation by means of the shade afforded by trees and the cover of stands of grass or grain. B. C.

[1] (1) "Geology and Ground Waters of North-Eastern Arkansas." By L. W. Stephenson, A. F. Crider, and R. B. Dole.
(2) "Geology and Underground Water of Luna County, New Mexico." By N. H. Darton.
(3) "Ground Water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook Areas, Connecticut." By H. E. Gregory and A. J. Ellis.
(4) "Ground Water in San Joaquin Valley, California." By W. C. Mendenhall, R. B. Dole, and H. Stables.
(Published by United States Geological Survey, Washington Government Printing Office, 1916.)

SCIENCE AND INDUSTRY.

THE important and impressive review of the rise and progress of the organic chemical industry issued by Messrs. Levinstein, Ltd., of Blackley, near Manchester, and of Ellesmere Port, which appeared as a supplement to the *Manchester Guardian* of June 30, marks a welcome development of industrial enterprise. Even the most indifferent and ill-informed reader cannot but be made aware, as a result of its perusal, of the importance of the highest facilities for scientific education and training, when in so striking a fashion he is compelled to realise the fruits of it in the enormous industrial advance of Germany in all that pertains to the organic chemical industries, whether it takes the form of artificial dyestuffs, synthetic organic products, or that of chemico-therapeutics. The advent of the war quickly laid bare our serious deficiencies, not to say our utter poverty, in all three departments of chemical manufacture.

In the course of the articles, which have been written by men eminent in their respective fields of chemical science and its applications, the distinction is made absolutely clear as between industries the development of which has mainly been the result of the adoption of steam power and of mechanical appliances, and those depending upon fundamental researches of a physical and chemical character, such as are, to use the phrase of one of the writers, "built up from the depths," and require, therefore, not merely the energetic business organiser and "scientific management," with a view to output, but the highly trained scientific man capable of appreciating the discoveries of pure science and apt in their application to human needs. In this valuable review of the progress of the many departments of a vital industry—the key, indeed, to the successful prosecution of many allied and dependent industries—it is clearly revealed how remiss the nation has been in a true appreciation of what constitutes the firm foundation of industrial pre-eminence. The fault has lain not so much, as some of the writers seem to indicate, with the colleges and universities as with the industries concerned, which have hitherto offered small salaries and poor prospects to the carefully trained and competent science student; indeed, have looked upon

the chemist as a necessary evil, to be avoided if possible.

One of the most important articles is that by Dr. Levinstein, inasmuch as he carefully points out the respective spheres of the university and the works in the effective training of the future industrial chemist. Once those concerned with the successful administration of our industries realise the necessity for encouraging by a liberal payment the work of the efficiently trained chemist there will be no lack in the supply of suitable men. That the nation contains such men has been shown by the fact that the demands of this devastating war for the supply of high explosives have been met with an energy and an efficiency which have surprised our chief enemy.

THE AMERICAN ASSOCIATION.

STANFORD MEETING OF THE PACIFIC DIVISION.

THE second annual meeting of the Pacific Division of the American Association for the Advancement of Science was held at Leland Stanford Junior University on April 5–7. In all a series of twenty-two sessions was provided, at which more than 130 papers were presented. At a general session on the evening of April 5 an address was given by Dr. J. C. Branner, retiring president of the Pacific Division, upon "Some of the Scientific Problems and Duties at Our Doors," and on the evening of April 6 Dr. F. J. E. Woodbridge, professor of philosophy at Columbia University, presented an address upon "History and Evolution."

One of the principal features of this meeting was a symposium arranged under the direction of Dr. D. T. MacDougal, director of the Desert Laboratory, Carnegie Institution of Washington, Tucson, Arizona, upon "Co-ordination and Co-operation in Research and in Applications of Science," at which the following addresses were given:—"Science and an Organised Civilisation," W. E. Ritter; "The National Research Council as an Agency of Co-operation," A. A. Noyes; "Plans for Co-operation in Research among the Scientific Societies of the Pacific Coast," J. C. Merriam; and "The Application of Science," W. F. Durand. Abstracts of the two written reports of the symposium are subjoined.

The ideals expressed in this symposium were given action in the formation of a Pacific Coast Research Conference, composed of the Pacific Coast Research Committee (which is a sub-committee of the Committee of One Hundred on Research of the American Association), and of representatives of societies affiliated with the Pacific Division. The purpose prompting the organisation of this conference is further expressed in the following resolution:—"Whereas it is the opinion of this conference that the important scientific problems before men of science to-day are those problems relating to preparation for war, which require scientific research, therefore be it resolved that this conference, representing the scientific interests of the Pacific Division of the American Association for the Advancement of Science, offers to the State Council of Defence already formed in California, and to such other similar State or national organisations as may be organised, the full support and assistance of this conference in so far as it may be desired for the direction of research upon problems arising out of a condition of preparation for war."

Science and an Organised Civilisation.[1]

The importance of science in Western civilisation is abundantly recognised. The dependence upon it of agriculture, manufacture, commerce, hygiene, medicine, war, etc., gives it an enormous and secure place in all modern society. Questions of its becoming still more serviceable in these ways no longer concern the fact and general principles of its usefulness, but only matters of its financial support, its special agencies and methods, and its further specialisation and organisation. My commission is to speak about science not so much as an element in civilisation as an interpreter of, and a general contributor to, the very essence of civilisation itself. The propositions supported are:—

(1) That in a catastrophic time like the present, when the social and political conventions and practices and ideas by which civilisation is guided under normal conditions are largely shattered, men are thrown back on the basic principles of their natures to a degree not approximated at other times.

(2) That such conditions are exactly those for science to take cognisance of, and to bring its methods and accumulations of knowledge to bear upon, to the end of making the new *régime* which shall supervene more in accord with the basic principles of man's nature than were those of the old *régime*.

(3) That the scientific men of the Americas, particularly of the United States, are specially well circumstanced to take a leading part in such a movement from the fact that their Governments and special institutions are avowedly (as through the Declaration of Independence, the organic law, and the Monroe Doctrine of the United States) based more on the fundamental nature of man than on political and social tradition.

(4) That in view of this it is the duty of American men of science to exert themselves to the utmost to secure due recognition and participation of science in the gigantic problems of national and international readjustment by which the world will soon be confronted.

The Application of Science.[2]

There are two fundamental motives determining interest in science: (1) a desire to know the universe, its constitution, phenomena, and laws of evolution; and (2) a desire that the facts disclosed may be applied to the service of humanity.

The broadest significance of a fact of science is only reached when it is applied to some useful end. Without such application its significance is limited to its intellectual or æsthetic appeal. With such application it takes its place as one of the factors in the life of humanity.

Not all facts of science are equally susceptible of useful application. Some possibly may have no such application. It is impossible to foresee the future, however, and it is not unreasonable to assume that, in a large way, all facts of science contain the potential of some useful application at some stage in the evolution of humanity on the earth.

The problem of the application of the facts of science is that of bridging the gap between the observed fact and the correlated demand presented by the needs of civilisation. This problem divides under two types. (1) Given a fact of science, what are its applications? (2) Given a need of civilisation, what is the foundation in science for meeting the need?

The factors most likely to be of significance in dealing with the first problem are (1) imagination or vision; (2) wide acquaintance with the needs of humanity as expressed in terms of their scientific elements. For the second typical problem there are required likewise (1) imagination or vision, and (2) wide acquaintance with the facts of science likely to bear upon the specific problem in hand.

[1] By William E. Ritter, Director, Scripps Institution for Biological Research, La Jolla, California.

[2] By Prof. W. F. Durand, professor of mechanical engineering, Stanford University, California.

In detail the field is too vast for compass by any one human mind. The situation is, moreover, becoming more and more aggravated by the rapidly growing accumulation of the facts of science. There is specific need for the development of a new branch of science, the science of the use of science. Some of the factors of such a science or scientific method are presumably (1) the development of a great clearing-house of scientific facts and human needs, with improvement in methods of classifying and storing away such facts in the record; (2) the development of a special type of mind keen to detect correspondence between the needs of humanity and the facts of science; (3) the organisation of a corps of workers under the guidance of such trained and developed minds, and whose purpose shall be the working out of the correspondences noted above.

In any exhaustive or complete sense the field seems too vast to be compassed by human effort. Both the accumulated store of science and the pressing needs presented by our modern complex civilisation have far outrun the seeming compass of any method we can imagine whereby such correspondences might be determined in a definite and assured manner. Because the field is too vast for compass in an exhaustive or complete manner, however, it does not follow that no effort whatever should be made. On the contrary, it seems clear that something should be done towards the development of a more orderly method for the establishment of correspondence between the needs of humanity and the facts of science, and we should look forward to this effort as one of the distinctive marks of progress in the twentieth century—the beginning, at least, of the development of a science of the use of science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Education Committee of the London County Council has approved a grant of 26,140*l.* per annum to the University for the three years 1917–20. This is an increase of 1460*l.* over the grant for 1916–17. Increased grants are given to the Evening School of History at University College, 140*l.*; to Italian, 600*l.*; to Slavonic languages, 500*l.*; and to phonetics at University College, 220*l.* It is proposed to establish a professorship in Italian, and the Senate is asked to prepare a scheme for the teaching of this language. A chair in Russian is also to be established, and the work will be concentrated at King's College. The other grants remain unaltered as to amount or purpose, including the block grant of 10,000*l.* in accordance with the Technical Education Board scheme. Importance is attached by the Senate to the development of phonetics, and it is pointed out that a large phonetic laboratory was fitted out on a lavish scale a few years ago in connection with the Colonial Institute at Hamburg. The higher sub-committee states that, "having regard to the increasing importance of a knowledge of modern European languages to those engaged in commerce, and also to the large number of languages spoken in the British Empire, it appears that the provision for the teaching of phonetics in England cannot be regarded as adequate." An increased grant of 220*l.* for the teaching of phonetics is accordingly sanctioned. The maintenance grant of 300*l.* per annum is to be continued to Bedford College for the next three years.

THE somewhat novel experiment of using a private garden for educational purposes has of recent years been tried at "Westfield," Reading, by Dr. J. B. Hurry, and has excited considerable interest amongst the teachers and older school children, as well as amongst residents of that town. A number of plots have been laid out in which are grown a variety of plants used in industry and commerce. Series A includes plants used in medicine, *e.g.* eucalyptus, belladonna, aconite, stramonium, gentian, liquorice, podophyllin, asafœtida, valerian, henbane, castor oil, cinchona, and the opium poppy. Series B includes plants used for food, *e.g.* maize, millet, sugar, rice, bananas, arrowroot, ginger, chicory, pepper, olive, and cardamoms. Series C includes plants used for clothing and textiles, such as flax, hemp, cotton, jute, *Phormium tenax*, and ramie nettle. Series D includes plants that yield dyes, such as woad, indigo, madder, dyer's weed, turmeric, anatto, and alkanet. In the adjacent conservatories are exhibited more delicate economic plants, such as tea, coffee, soya beans, monkey-nuts, guava, chick pea, cinnamon, and camphor. Adjoining the conservatories is a small museum in which are collected various products made from the above-mentioned plants, every article being accompanied by a descriptive label, so that the living plant can be studied in conjunction with the economic products derived from it. Every summer the garden, conservatories, and museum are thrown open free on several half-holidays to visitors and the older school children of the borough, who in large numbers avail themselves of the privilege of seeing some of the important plants used in industry. A printed catalogue is supplied to every visitor, and from time to time demonstrations of the more interesting exhibits are given by Dr. Hurry and his assistants.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—Sir J. J. Thomson, president, in the chair.—Sir Napier **Shaw**: Revolving fluid in the atmosphere. It is generally assumed, as appears particularly from a recent paper by Lord Rayleigh with reference to a former paper by Dr. J. Aitken, that the motion of air in cyclones and anticyclones may be classed as the motion of revolving fluid, symmetrical about a vertical axis. Reasons are given to show that this assumption with regard to cyclones and anticyclones of middle latitudes is erroneous; that circular isobars on the map do not indicate revolving fluid, and, *vice versa*, that travelling revolving fluid would not be indicated by a system of circular isobars. The next point for consideration is how a mass of revolving fluid travelling with a speed of translation of the same order as the speed of rotation, and of sufficient size, would be represented on a map. Diagrams are drawn showing the distribution of velocity in four cases for different ratios of the velocity of translation to the velocity of rotation, and assuming that systems of velocities could be fitted to pressure lines of the same shape, it is inferred that cases of travelling revolving fluid would be indicated by isobars similar to those which are classed meteorologically as belonging to small secondaries, or distortions of the isobars, generally on the southern side of the great cyclonic systems. Conditions are next considered which must exist if a column of rotating fluid is maintained and transported within a current represented by the isobars of a great cyclonic depression. The conditions arrived at are briefly:—(1) That the velocity of translation must be the velocity corresponding with the separation of the isobars of the main depression unaffected by the presence of the revolving mass. (2) The column must probably extend throughout the troposphere, otherwise it could not be "capped." (3) The velocity of the current

transporting the revolving fluid must be the same at all heights. This condition is shown to be satisfied if the line of lapse of temperature with height in the atmosphere corresponds with an adiabatic line, and this is known to be approximately the case in a cyclonic depression where convection has been ubiquitous and vigorous.—Prof. A. **Fowler** and Hon. R. J. **Strutt**: Absorption bands of atmospheric ozone in the spectra of sun and stars. In this paper it is shown that a series of narrow bands in the ultra-violet absorption spectrum of ozone appears in the spectra of the sun and stars near the extreme end of the photographic spectrum. The atmospheric origin of these bands is proved by the increase in their intensity in the solar spectrum as the sun's altitude is diminished. The observations are considered strongly to confirm the view of Hartley that ozone is the constituent of the atmosphere which limits the spectra of celestial bodies in the ultra-violet.

Mineralogical Society, June 19.—Mr. W. Barlow, president, in the chair.—Dr. G. F. H. **Smith**: The problem of sartorite. The examination of crystals kindly supplied for the purpose by Dr. C. O. Trechmann and Mr. R. H. Solly showed that the faces fall into zones which are only partially congruent. Just as in the case of calaverite, earlier investigated by the author, there appear to be simultaneously in certain of the crystals five distinct lattices. The vertical spacing and the relative positions of the vertical planes remain unchanged, but in passing from the central lattice to the two lying on either side there is a distinct shear which varies in direction, though apparently not in amount, from crystal to crystal.—Dr. A. **Scott**: Note on a curious case of devitrification. The glass of an old bottle found in river sand about 4 ft. below the surface in Leven Shipyard, Dumbarton, has become almost completely crystallised. The crystals, which have a composition corresponding nearly to $2CaO.Na_2O.5SiO_2$, are accompanied by some dark-coloured microlites. A piece of a glass which by accident had been allowed to cool slowly showed the same crystals and microlites, and, in addition, a few small needles with high refraction and large birefringence.—Dr. G. T. **Prior**: The meteorites of Simondium, Eagle Station, and Amana. The results of analyses showed that the Amana stone belonged to the cronstadt, with some approach to the baroti type; that Eagle Station is an exception to other pallasites in containing iron richer in nickel, and olivine correspondingly richer in ferrous oxide; and that Simondium was closer to the grahamites than to the howardites, since, like other grahamites, it contained nickeliferous iron and olivine in chemical composition similar to those of the pallasites, but with pyroxene and anorthic felspar similar to those of the howardites and eucrites.

Royal Microscopical Society, June 20.—Mr. E. Heron-Allen, president, in the chair.—F. M. **Duncan**: A note on the fertilisation and deposition of ova in *Portunas depurator.* The author had recently been able to observe the repeated deposition of fertile ova by a female crab after one copulation. The first batch of ova were deposited attached to each other in the typical manner. In later depositions the ova were separated from each other, and rested on the floor of the tank like grains of sand. Every care was taken to preclude the possibility of free spermatozoa being present in the water of the tank containing the female crab. This rarely observed phenomenon had been confirmed by Dr. H. C. Williamson and Mr. H. J. Waddington.—E. **Heron-Allen** and A. **Earland**: *Nouria rugosa,* a new Foraminifer from the Shetland-Faröe Channel. This representative of a Lituoline genus hitherto recorded only by the same authors from tropical and Australian seas constructs a polythalamous shell of minute siliceous spicules of curved *oxea* type, derived from some sponge which, so far, has not been identified, and is isomorphous in structure with the perforate species, *Polymorphina angusta,* Egger, and *P. lanceolata,* Reuss.

VICTORIA.

Royal Society, April 12.—Mr. W. A. Hartnell, treasurer, in the chair.—R. T. **Patton**: Timber production and growth curves in the mountain ash (*Eucalyptus regnans*) Measurements and calculations have been made on a large series of cut timber at Powelltown, and the general conclusion regarding the annual development of wood in this species of Eucalypt is that it reaches its maximum at fifty years, and that the most profitable time for cutting is between the sixtieth and seventieth years. These appear to be the first investigations of the kind made on Australian timber. —Prof. E. W. **Skeats**: Coral-reef and dolomite problems in relation to the formation of atolls.

WASHINGTON, D.C.

National Academy of Sciences, April 15 (Proceedings. No. 4, vol. iii.).—R. A. **Millikan**: A re-determination of the value of the electron and of related constants. The values for the charge on the electron, the Avogadro constant, etc., are given, with estimates of the accuracy of the result.—J. A. **Harris**, A. F. **Blakeslee**, and D. E. **Warner**: Body pigmentation and egg production in the fowl. A strong negative correlation exists between the October ear-lobe pigmentation and the egg production of the year.—A. J. **Goldfarb**: Variability of germ-cells of sea-urchins. The varying behaviour of the eggs in the experiments of Loeb, Lillie, Wasteneys, and others was apparently due in large part to variation in the physiological condition of the eggs they used.—G. **Harrison**: Transplantation of limbs. The experiments confirm previous ones, showing that the limb bud is a self-differentiating body; they also show that the laterality of the forelimb may be affected by its new surroundings.—I. **Langmuir**: The shapes of group molecules forming the surfaces of liquids. Cross-sections and lengths are calculated for a variety of molecules. Various theoretical conditions are developed.—F. J. **Alway** and G. R. **McDole**: The importance of the water contained in the deeper portions of the subsoil. The moisture of the deeper subsoil will be able to move upward only so slowly and through such a short distance in a single season that it will be at most of no *practical* benefit to annual crops.—W. N. **Berg**: The transformation of pseudoglobulin into euglobulin. The loss of pseudoglobulin in the heated sera corresponds almost quantitatively with the gain of euglobulin in the same sera.—H. E. **Jordan**: A case of normal embryonic atresia of the œsophagus. A description of the phenomenon for turtles.—H. **Shapley**: Studies of magnitudes in star clusters. V., Further evidence of the absence of scattering of light in space.—H. E. **Jordan**: The history of the primordial germ-cells in the loggerhead turtle embryo.—H. **Shapley**: Studies of magnitudes in star clusters. VI., The relation of blue stars and variables to galactic planes. The stellar distribution in the so-called globular clusters has an underlying elliptical symmetry; therefore not only certain nebulæ, our solar system, and the whole galactic system, but even the globular clusters have the oblateness that is general and fundamental in the dynamics of stellar groups.—L. **Spier**: Zuñi chronology. It has been found possible to establish a chronological scale with applications to American culture history.—E. W. **Berry**: The age of the Bolivian Andes. There is definite evidence that parts of the

high plateau and of the eastern Cordillera stood at sea-level in the late Tertiary.—W. H. **Bucher**: Large current-ripples as indicators of palæogeography. A study of the Cincinnati anticline.—E. C. **MacDowell**: The bearing of selection experiments with Drosophila upon the frequency of germinal changes. A study of extra bristles indicates that they are primarily occasioned by one germinal unit, and that no change of evolutionary or practical significance has occurred during fifty generations.—S. **Taber**: Pressure phenomena accompanying the growth of crystals. Many phenomena connected with the metamorphism of rocks, the growth of concretions, and the formation of mineral deposits are difficult to explain under any other hypothesis than that growing crystals have made room for themselves by exerting pressure on the surrounding material.—T. B. **Johnson** and A. A. **Ticknor**: A new method of transforming esters of α-amino-acids into their corresponding isothiocyanates.—W. G. **Foye**: The geology of the Fiji Islands. It cannot be said that the modern reefs of Fiji fully support Darwin's theory.—D. F. **Jones**: Dominance of linked factors as a means of accounting for heterosis.—E. F. **Smith**: Chemically induced crown-galls. Small tumours have been produced by the application of various chemicals.—G. D. **Birkhoff**: Dynamical systems with two degrees of freedom.

BOOKS RECEIVED.

Transactions of the Royal Society of Edinburgh. Vol. li., part ii. Session 1915–16. Vol li., part iii. Sessions 1915–16–17. (Edinburgh: R. Grant and Son.) 33*s*. and 35*s*.

Modern Man and his Forerunners. By H. G. F. Spurrell. Pp. xi+192. (London: G. Bell and Sons, Ltd.) 7*s*. 6*d*. net.

A Year of Costa Rican Natural History. By A. S. Calvert and P. P. Calvert. Pp. xix+577. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

Microscopic Analysis of Cattle-foods. By T. N. Morris. Pp. viii+74. (Cambridge: At the University Press.) 2*s*. net.

The Biology of Dragonflies. By R. J. Tillyard. Pp. xi+396. (Cambridge: At the University Press.) 15*s*. net.

Fossil Plants: a Text-book for Students of Botany and Geology. By Prof. A. C. Seward. Vol. iii. Pp. xviii+656. (Cambridge: At the University Press.) 18*s*. net.

Explosives. By A. Marshall. Second edition. Vol. ii. Properties and Tests. Pp. ix+411 to 795. (London: J. and A. Churchill.) 3*l*. 3*s*. net two vols.

The Statesman's Year Book, 1917. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xliv+1504+4 plates. (London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

The Standard Cyclopædia of Horticulture. By L. H. Bailey. Vol. vi., S–Z. Pp. v+3043 to 3639+plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 25*s*. net.

Health and the State. By Dr. W. A. Brend. Pp. xi+354. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

Practical Chemistry for Medical Students. By Dr. A. C. Cumming. Second edition. Pp. 8+165. (Edinburgh: J. Thin.)

How to Know the Ferns. By S. L. Bastin. Pp. viii+136. (London: Methuen and Co., Ltd.) 1*s*. 6*d*. net.

Farm Forestry. By Prof. J. A. Ferguson. Pp. viii+241. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Introduction to the Rarer Elements. By Dr. P. E. Browning. Fourth edition. Pp. x+250. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

Steam Turbines. By J. A. Moyer. Third edition. Pp. xi+468. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

A Bibliography of British Ornithology from the Earliest Times to the End of 1912. By W. H. Mullens and H. Kirke Swann. Part vi. (London: Macmillan and Co., Ltd.) 6*s*. net.

Researches of the Department of Terrestrial Magnetism. Part iii. Oceanic Magnetic Observations, 1905–16, and Reports on Special Researches. By L. A. Bauer and others. Pp. vii+447. (Washington: Carnegie Institution.)

The Human Worth of Rigorous Thinking. By Prof. C. J. Keyser. Pp. 314. (New York: Columbia University Press; London: H. Milford.)

Soil Conditions and Plant Growth. By Dr. E. J. Russell. Third edition. Pp. viii+243+diagrams. (London: Longmans and Co.) 6*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, JULY 6.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on Volcanic Phenomena in New Zealand: Miss M. S. Johnston.—Flint-working Sites in the Submerged Forest of Carmarthen Bay: A. L. Leach.

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Editorial and Publishing Offices:

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THURSDAY, JULY 12, 1917.

ACIDS AND THE WAR.

The Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches. A Theoretical and Practical Treatise. By Dr. G. Lunge. Fourth edition. Supplement to vol. i., *Sulphuric and Nitric Acid.* Pp. xii+347. (London: Gurney and Jackson, 1917.) Price 15s. net.

THE veteran professor emeritus of the Federal Technical University of Zürich would seem to be devoting his well-earned leisure almost exclusively to the emendation of those monumental treatises on chemical technology with which his name is so honourably associated. Scarcely four years have elapsed since he brought out the fourth edition of his well-known work on "The Manufacture of Sulphuric Acid and Alkali," and it has now become necessary to issue a supplementary volume dealing more particularly with sulphuric and nitric acids.

The crisis through which the world is now passing has led to an extraordinary extension in the manufacture of these substances. Here, as in other matters, necessity has been the mother of invention. Some old processes, it is true, have been resuscitated, but far more new and original ones have been devised. Some of these are only vaguely known, as, for obvious reasons, few details have been allowed to transpire. It is, of course, too soon to speak with confidence concerning their ultimate fate. The times are so utterly abnormal that all ordinary economic considerations are thrown aside. Sulphuric and nitric acids *must* be had; they are absolutely necessary to the national existence of all the belligerents, and if the usual sources of supply are not available or are insufficient, other or additional means must be found. To the nations which have more or less ready access to the sea the conditions are not so strenuous as they undoubtedly are to the Central Powers, and it is in the latter case that the new developments referred to have been most marked. Many outside sources of sulphur, pyrites, and nitrates were quickly cut off from Germany and Austria, and there is no doubt that at one period in the history of the war they were threatened with collapse owing to a shortage of these materials. The inventive genius of their chemists, however, would appear to have surmounted this crisis, and the world has been informed on high authority that Germany, and presumably also Austria, are no longer under any apprehension that the supply of their munitions is in jeopardy from this cause.

As regards these matters, it is scarcely to be expected that Dr. Lunge is able to afford much information. We shall have to wait for the conclusion of hostilities to learn what permanent changes have been effected in this branch of manufacturing chemistry in Central Europe. But, so far as can be foreseen, they will probably not be very profound, at least as regards principles. The stress of competition will tend, as hitherto, to approximate methods to a standard and practically uniform type. In this respect history will repeat itself. Under the pressure of necessity many processes have had to be adopted in war-time which are promptly abandoned when peace is resumed and the world's markets are once more available. At the same time experience gained under such conditions is bound to have a profound influence on the development of chemical technology. The war has had a tremendous "hustling" effect upon chemical manufactures of all kinds and in all countries in which this industry has any importance. All the portents go to show that the Germans are becoming nervously apprehensive that their pre-eminence in certain directions is now seriously assailed. There was a time when, for example, in the matter of synthetic dyestuffs, they treated the rest of the world with contemptuous indifference. The annual reports of such a powerful combination as the Badische Company are now couched in very different terms from those which prevailed prior to 1914. They no longer have an uncontrolled command of oversea markets, and they realise that fact.

Dr. Lunge's new volume is, as its title states, strictly supplementary. It corrects any errors which may have been detected in the last edition, and adds such new matter as may have been published in the ordinary technical journals since 1912-13, or which may have been communicated to the author from private sources. It consists practically of a series of notes, each of which starts with the number of the page in the main work to which the note refers, or to which it may be regarded as an appendix. In general arrangement, therefore, it follows strictly the plan of the larger work. Dr. Lunge is evidently a most assiduous reader of the literature of chemical technology, and nothing relating to those branches of manufacture with which he has been more immediately concerned seems to escape his notice. His study is a veritable clearing-house in regard to such subjects, and what he fails to note is probably scarcely worth noting. Indeed, if he errs at all, it is, perhaps, that his chronicle is too full; he occasionally notices, with a meticulous care, things which have no abiding place in technology, and which even the most receptive of practical men would willingly let die. Still, if it is a fault, it is an error in the right direction, which all who appreciate his zealous and long-continued services in the cause of chemical technology will gladly condone.

T.

THE HEAT TREATMENT OF STEEL IN PRACTICE.

Steel and its Heat Treatment. By Denison K. Bullens. Second impression, with additions. Pp. vii+441. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 17s. 6d. net.

THE heat treatment of steels is an art of recent growth. Twenty years ago it could scarcely be said to exist. Such as it was, it usually consisted in "heating to a red heat" for annealing,

or perhaps the instructions called for "harden at a bright red and temper to a straw colour." It was an art guarded with much secrecy and confined chiefly to makers of tools. Pyrometers, structural changes, and a knowledge of the thermal equilibrium diagram of the steel in question were not even thought of. To-day it may be said without exaggeration that modern engineering practice at its best would be impossible were it not based largely upon an art which requires for its performance scientific knowledge, skill, and judgment of a very high order. With the exception of steels very low in carbon, there is scarcely one—certainly no alloy steel—which does not require a precisely defined heat treatment, depending upon the purpose to which it is to be put, if the best value is to be got out of it. Of this the steels used in the automobile industry furnish a conspicuous illustration. The frame, the front and rear axles, the steering parts, springs, crank-shafts, and gears, all have a more or less severe duty to perform and require steels possessing particular qualities of strength, toughness, resilience, endurance, shock resistance, and good wearing properties, which are obtained by suitable heat treatment.

Mr. Bullens has written a very serviceable book on the above subject, of which the first edition was quickly exhausted. The second edition, which we have before us, is a reprint of the first, with an appendix on the heat treatment of modern high-speed tool steels. The opening chapters deal with the testing and structure of steels, and the operations of annealing, hardening, tempering, and toughening. Then follow two on case-carburising and case-hardening, which are exceedingly good. The author has evidently studied Giolitti's researches with great profit to himself and turned the knowledge gained to practical account. An interesting illustration of cast-iron "growth" is furnished by his statement that this is an unsuitable material for case-carburising boxes, whereas malleable iron, soft steel, and wrought iron can all be used. The next two chapters, on the generation and application of heat, are also very valuable, and show the author's practical acquaintance with furnace design, construction, and operation.

The remainder of the book deals with the particular heat treatments in vogue for carbon and alloy steels. Among the latter, nickel, chromium, and nickel-chromium steels occupy an important place. Indeed, nickel steels were the pioneers among the alloy steels. Nickel was originally added merely to give increased strength and toughness over that obtained in ordinary rolled structural steel. When heat treatments were also applied they were found to enhance the valuable qualities of the alloys to such an extent that they soon came to hold, and still maintain, the premier position in alloy-steel metallurgy. The concluding chapters deal with vanadium, manganese, and silicon steels, and various types of tool steel.

The book is one to be warmly commended; it is well written and, on the whole, very accurate in its statements. H. C. H. C.

SCHOOL AND PERSONAL HYGIENE.

(1) *Crowley's Hygiene of School Life.* By Dr. C. W. Hutt. Pp. xv+428. (London: Methuen and Co., Ltd.) Price 3s. 6d. net.

(2) *Syllabus of Personal Hygiene for Colleges.* By Prof. E. C. Howe. Third revision. Pp. 207. (Wellesley, Mass.: The Author.)

(1) DR. CROWLEY having accepted an appointment in the Medical Department of the Board of Education, the preparation of a second edition of his "Hygiene of School Life" has devolved upon Dr. Hutt, who has altered, extended, and rewritten where necessary much of the original work. Dr. Hutt has had the task of selecting from a vast amount of material to be found in official reports; this he has performed with good judgment, and his conclusions are sound and convincing.

The position taken in the book is that of the administrator who is limited by the various enactments dealing with the medical and hygienic problems concerned with education, and such subjects, therefore, as over-pressure, the curriculum, and the physiology of writing and of reading have, perforce, to be omitted. The contents include, in order, the physical condition of the child, classification and groups of school children, the infant and infants' schools, medical treatment of school children, the provision of school meals, baths, games and exercises, open-air education, the school and infectious diseases, and the school building. The book is illustrated with some plates and a number of diagrams and plans, and the price is exceedingly moderate.

From the point of view of the administrator who has to deal with things as they are, we do not think that the student of school hygiene can select a better guide than this second edition of Crowley's "Hygiene of School Life."

(2) Prof. Eugene Howe, of Wellesley College, Mass., gives in this book a syllabus of a course of personal hygiene suitable for the students of a general educational institution. The course is divided into thirty lectures. An abstract of each lecture is given, and the right-hand pages are left blank for notes by the student. At the end of the book a bibliography is added, under the various subjects dealt with, of works and papers suitable for further study. The subjects seem to be well chosen and the treatment of them satisfactory. While presumably intended for Prof. Howe's own students, those who may have to give courses of lectures in personal hygiene to lay audiences will find this book a suggestive and useful guide.

OUR BOOKSHELF.

The Elementary Principles of Wireless Telegraphy. By R. D. Bangay. Part ii. Second edition. Pp. viii+241. (London: The Wireless Press, Ltd., 1917.) Price 2s.

THE aim of this work is to explain the theory and practice of wireless telegraphy to persons who do

not possess much knowledge of the theory of electricity. There is no attempt to give purely electrical explanations of the principles involved; instead, the author has made free use of a few well-chosen mechanical analogies, which are worked out in considerable detail.

The discussion of these mechanical vibration problems, with the help of torque-time and velocity-time curves, is a most attractive feature, of the greatest interest to students of physics and engineering.

Part ii. deals mainly with transmitting apparatus and develops the theories of the dynamo, transformer, coupled circuits, spark transmitters, and oscillation valves.

The treatment of these, though necessarily brief, is on the whole remarkably clear and accurate, and is illustrated by a large number of diagrams.

The section, about fifty pages, devoted to oscillation valves is very good indeed. These sensitive contrivances have almost revolutionised the art of wireless telegraphy during the past few years. Unfortunately, there is very little quantitative information given about them; a few more numbers would have been most welcome.

Scarcity of numerical illustrations is perhaps the chief defect of the book; the size of a piece of apparatus and the numerical values of its constants are rarely given. But this is not very serious, and we can warmly recommend the work as a trustworthy and stimulating introduction to the more elaborate treatises on radiotelegraphy.

Field and Laboratory Studies of Crops: An Elementary Manual for Students of Agriculture. By Prof. A. G. McCall. Pp. viii+133. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 3*s*. 6*d*. net.

THE object of this little book is to provide students of school age with practical exercises in the study of plant life. It is, as it were, a twentieth-century edition of the book of "Common Things" which bored the children of earlier generations. Unlike those forbidding compendiums, it seeks to lead children to a study of Nature through the avenue of experiment, and hence possesses a marked superiority over its early prototypes. Nevertheless, it has the fundamental defect of all those books which seek to evade the disciplinary grind which is the only passport into the world of science. Thus the student is supposed to learn how plants grow by marking corn roots with thread or waterproof ink, and he is advised to draw an entirely erroneous conclusion, namely, that sunlight is necessary for plant growth from an experiment in growing plants in the dark. Having performed the experiment, he is *told* about carbohydrates and is *told* about photosynthesis, on which things and phenomena the experiment throws but little and faint light.

If "agronomists" think that a knowledge of the elements of plant physiology is useful to the budding agriculturist, it would be best to let him follow a simple but systematic course in that subject, and not to restrict him to a few odds and ends of experiments which serve for little else than occasions for providing "morals"—conclusions which may or may not follow from the experiments and statistics which, though valuable enough in themselves, have no legitimate relation with the experiment to which they purport to refer. For example (Exercise 9), the child digs up 5 lb. of clover or corn, and, having determined that, when exposed to the sun, it loses a considerable part of its weight, is informed that a field of oats uses 522 lb. of water for each pound of dry matter produced.

We fear that this attempt to get the child "rich quick" is doomed to failure, and we do not believe that even the American child will make much of a success of his garden by studying Exercise 50, on "Planning the Home Garden," pp. 122-24, or even by purchasing the apparatus required for the exercise—to wit, a 50-ft. tape and some plain drawing-paper.

F. K.

Dairy Farming. By Prof. C. H. Eckles and Prof. G. F. Warren. Pp. xv+309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5*s*. net.

As was to be expected, the chapters dealing with the breeds of cattle, their selection, improvement, management, feeding, etc., have been written by Prof. Eckles, and follow the lines of his own book on that subject. He has also contributed a chapter on the common ailments of cattle, and one on milk and its products. Prof. Warren's contribution deals with the why and wherefore of dairying and dairy farming, and a great deal of information is given on matters which are not, as a rule, gone into very exhaustively by the average teacher in this country. Nevertheless, such information is of the greatest possible benefit in developing the mind of the future farmer and giving him an outlook which will carry him above rule-of-thumb methods.

This book is intended for teaching purposes, and there are questions and problems at the end of each chapter, also a list of books in some cases which may be read with advantage.

The modern farmer will find much that will interest him in this book, particularly in view of the changing conditions in our country at the present time, and there seems to be every reason why the value of the dairy cow as an economical producer of human food should be strongly pointed out to those already engaged in farming, as well as to those who are prospective farmers.

It is, however, chiefly as an aid to the teacher that this book is to be strongly recommended, and whilst the examples refer to American conditions, it ought to be possible to get similar data for British farms and utilise the information to the same ends.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Synchronous Signalling.

THE following Board of Trade notice to mariners, recently issued, is one of exceptional interest and importance; for, thanks to American initiative, we find here for the first time a practical application of the principles of synchronous signalling.

"NEW YORK HARBOUR APPROACHES.—*Fire Island L/V.* Radio Dist. Determining Apparatus Installed. —The attention of all ships nav. the approaches to New York Harb. is invited to the recent installation on Fire Island L/V. of a combined radio and submerged sound sig. transmitter which determines the receiving ship's distance from the L/V. (Call letters NLS.; station, 40° 28′ 40″ N., 73° 11′ 26″ W.)

"This apparatus will be in operation during fog, mist, rain, or falling snow. The range of this apparatus is limited to the receiving range of the submarine bell receiving equipment employed on shipboard, and in all practical cases this is within six or seven miles. The submarine bell strikes six strokes, pause, then eight strokes once every 38 sec. Beginning shortly after the first stroke of the '6' submarine character, about ½ sec., the ship emits a series of radio sigs. In order to determine the dist. of a ship from the L/V. it is necessary to count each of these radio dots until the *first stroke of the six submarine sigs. is received.* The number of dots thus determined gives the dist. in half sea miles from the L/V. Example:—(*a*) Eleven radio dots are received before the first stroke of the bell; the dist. is 11/2, or 5½ miles. (*b*) Four radio dots are received, the first submarine bell sig. appearing midway between the fourth and fifth radio sig.; the total number of radio sigs. received is 4½, and the dist. is 4½ divided by 2, or 2¼ miles. The most convenient method of receiving these sigs. is to have one receiver connected to radio and the other receiver connected to submarine bell detector, thereby connecting one ear to radio sigs. and the other to submarine sigs. These sigs. will also be furnished in clear weather when requested to do so by radio. It is requested that all passing vessels equipped with submarine sig. receiving apparatus familiarise themselves with this apparatus and report success obtained to the Hydrographic Office. Wave length used is 600 metres. Watches are stood as follows:—(1) Continuously during thick weather. (2) During clear weather, first 15 min. of every hour from 8 A.M. to 9.15 P.M. Although this station has proved accurate on test, the apparatus is in an exper. stage, and too much reliance should not be placed on it until its worth has been proved under service conditions."

It will be understood that the particular mode of applying synchronous signals herein described enables the mariner to dispense with the use of stop-watch or chronometer. The ordering of the faster-travelling signals is such as to supply the place of a timepiece. If a wireless and submarine signal be started together, the latter lags 1·2 sec. for each mile travelled, or for each half mile the lag is 0·6 sec. Hence if the instantaneous signal is repeated every 0·6 sec., the first of these being emitted 0·6 sec. after the first submarine signal, the mariner at half mile distance from the shore station gets both initial signals together. At one sea mile he gets the first submarine signal along with the second radio dot; at one and a half sea miles the third radio dot coincides with the first submarine bell stroke. Hence the rule: Divide by 2 to find the distance in sea miles. If the mariner is closer than half a mile the submarine signal comes in first. It is, perhaps, open to question if this is better than the arrangement of starting the signals at the same instant. In the latter case the mariner counts up the radio dots until the submarine signal is heard, subtracts 1, and divides by 2. In this ordering he always hears the radio signal first.

It is to be hoped that this will be a successful inauguration of a reform in maritime signalling. Our signalling stations are not nearly so valuable as they would be if synchronous signalling was made more general. In many cases the more important apparatus required is already installed. It must be borne in mind that both light-flash and aerial sound signals of abrupt character may be used in synchronous signalling.

The application of synchronous signalling to avoiding collision at sea is perfectly simple, and the step now taken should lead to its careful consideration and trial. In this case a vessel, A, when overtaken by thick weather, emits synchronous signals, say, every two minutes. This would be automatically effected by a clock-work contact maker. (The radio signals might consist of eight or ten consecutive dots spaced 0·6 sec. apart.) Another ship, B, hearing these, not only learns of the presence of A, but also gets her distance at once. B is also signalling, so that like information reaches A. Each ship now signals her course and speed. This is a familiar operation between ship station and shore station or between one ship station and another, and takes only a few seconds. The navigating officers on A and B then read on an instrument of simple construction (1) the rate at which the ships will be nearing one another, and (2) the mutual bearings of the two ships—*if collision is threatened.* And now after two minutes each officer, on receiving the second synchronous signal of the other ship, is able to say whether danger threatens him or not. For if this second signal tells him that the ships have approached each other by a certain distance during the two minutes (a distance read directly on the "Collision Predictor") there is danger of collision. If the distance covered is less than this (it cannot be greater), there is safety. The third synchronous signal may be used to confirm the result.

By this method, if the danger of permitting ships to sail in open waters unprovided with the requisite equipment (both instrumental and personal) be avoided by proper and stringent regulations, high speeds in open ocean could with safety be maintained in any weather.

J. JOLY.

Trinity College, Dublin.

Calculating Machines.

MAY I make an appeal through your columns to any men of science who have calculating machines of any kind not in active use to communicate with me? My laboratory has at present very heavy computing work of an *urgent* character in hand for a Government department. This keeps nine machines running almost incessantly, and when any machine gets out of order it is, in existing circumstances, almost impossible to get it rapidly and effectively repaired. Quite fancy prices are now being asked often for completely worn-out machines. If any one of the readers of NATURE has a machine in reason-

able condition, which is not in use, and is willing to part with it for work of national importance at a reasonable price, I should be glad to hear from him the particulars as to type, condition, and price desired. When the war is over machines will return to their normal price—indeed, will probably be at reduced prices, for the war has taught many persons their value, and the market will be wider than it has hitherto been, so that foreign monopolies are certain to be broken down. KARL PEARSON.

Department of Applied Statistics, University College, University of London, July 5.

The Hippocampus in Ancient Art.

REPRODUCTIONS of early figures of the common Mediterranean species of Hippocampus have been published by Prof. Raymond Osburn in the *Zoological Bulletin* for March, 1915, and also by the present writer in the annual report of the Smithsonian Institution for the same year.

It is remarked in the latter of these articles that no mention is found in Aristotle of this striking form of fish-life, and the term "Hippocampus" was used by the poets of classical antiquity as the name of a sea monster, half-horse and half-fish, on which sea divinities rode. Nevertheless, the design of the seahorse occurs not infrequently in the plastic arts of Hellenistic civilisation, both in Greece and in Italy. The seahorse is figured occasionally also among the island gems, as stated by Fürtwangler, who figures one of them (*Antike Gemmen*, vol. i., pl. v.).

Figures of animals, including fishes, represented in ancient Grecian vase paintings have been made the subject of special study by a young French artist, Morin-Jean,[1] and a compatriot of his, P. H. Boussac, has written interesting articles on fish designs inscribed in ancient Egyptian monuments.[2]

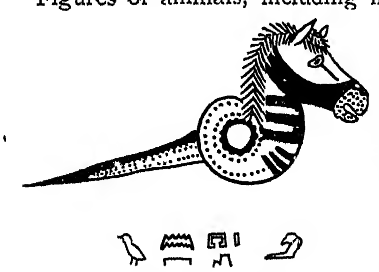

FIG. 1.—Hippocampus, from an Egyptian mummy-case, *c.* 500 B.C.

Only one instance is known where the Hippocampus is depicted in ancient works of art from the Nile valley. The design referred to forms part of a decorative painting in the interior of a mummy-case dating from the Twenty-sixth Dynasty (700–500 B.C.), now preserved in the City Museum of Gloucester. A brief description of it is given in vol. ii. of the "Historical Studies" published by the British School of Archæology in Egypt, and this is accompanied by a photograph of the original, which we have copied in the annexed figure.

Certain of the details are thus indicated in the description just referred to:—"The greater part of the Hippocampus is outlined in black on the white ground of the coffin; the ears, the eyes, the nostril, and the mane [*i.e.* conventionalised dorsal fin] are indicated in black; round the jaw is a wide black band edged with yellow; the muzzle is yellow with black dots; the wide horizontal stripes on the neck are alternately blue and red edged with black. . . . The date of the coffin accords well with the period of the archaic Athenian pediments." C. R. EASTMAN.

American Museum of Natural History, New York.

[1] "Le dessin des animaux en Grèce, d'après les vases peints." Pp. 262, illustrated. (Paris, 1911.)

[2] "Les poissons sur les monuments pharaoniques," *Le Naturaliste*, vols. xxxi. and xxxii. (1909–10).

THE HUNDRED-INCH REFLECTOR OF THE MOUNT WILSON OBSERVATORY.

BY the courtesy of Prof. Hale we are able to reproduce the accompanying interesting photographs relating to the giant reflector of the Mt. Wilson Observatory, which is now rapidly approaching completion.

The history of this great telescope dates from 1906, when Mr. John D. Hooker, of Los Angeles, presented the sum of 45,000 dollars to the Carnegie Institution for the purchase of a glass disc and to meet other expenses incident to the construction of a 100-in. mirror for a reflecting telescope of 50 ft. focal length. In making this gift, Mr. Hooker was well aware that the construction of such an instrument was to be regarded as an experiment, but in view of the great possibilities in astrophysical research which a large reflector seemed to offer, the experiment was considered to be well worth making. No insuperable difficulty was anticipated in the casting of a suitable disc by the French Plate Glass Company, of St. Gobain, and there was every reason for confidence in Mr. Ritchey's ability to grind and figure the mirror to the highest pitch of perfection. Experience already gained with the 60-in. telescope also gave confidence that the mounting of the larger instrument could be successfully accomplished.

Although no financial provision was made for the mounting and housing of the proposed telescope, Mr. Hooker's gift was accepted, in the confident belief that in due course a donor would be forthcoming.

An order for the disc was accordingly placed in the autumn of 1906, and the building in which the grinding, figuring, and testing of the mirror were to be carried on was erected during the following winter. In 1908 Prof. Hale reported that a disc had been successfully cast, but in the following year it was stated that on its arrival in California the disc exhibited many defects, and had been immediately rejected. The makers generously expressed their willingness to bear the loss and to make a further attempt. A large furnace and melting-pot capable of holding twenty tons of material were constructed, and improved methods of annealing were introduced. Early in 1910 another large disc was successfully cast, but owing to defects in the mould, strains were set up during annealing, and the disc was broken.

In view of this disappointment it was resolved to make a trial of the disc which had previously been laid aside, and grinding was commenced in the autumn of 1910. Meanwhile, further attempts to cast a disc free from flaws and bubbles were made, but again, owing to difficulties of annealing, a second disc was fractured in the oven. In the course of these trials, however, a flawless disc of the necessary diameter was produced, but its thickness was only 8 in., and this was not considered adequate to prevent deformation, unless a very perfect system of supports could be devised.

Mr. Hooker, unfortunately, did not live to witness any progress beyond this stage, having died on May 24, 1911.

In his report for the year 1912 Prof. Hale had the pleasure of announcing a great additional gift

FIG. 1.—Lowest section of 100-in. telescope tube, ready for transportation to Mt. Wilson.

to the Carnegie Institution by Mr. Carnegie, accompanied by the hope that adequate provision would be made for the completion of the 100-in. telescope. Plans for the mounting and for the observatory were accordingly prepared in elaborate detail, and work on the mirror was energetically continued. In addition, a 60-in. plane mirror, to be used in testing the 100-in. at its principal focus, was put in hand. Pending the trials of the mirror, however, actual construction work was not commenced until 1913. The smaller parts of the mounting, including the driving clock, were undertaken in the workshops of the observatory, and the larger by the Fore River Shipyards at Quincy, Mass. The dome, 100 ft. in diameter, was undertaken by the Morava Construction Works in Chicago.

Not the least of the difficulties to be faced was that of transporting materials and heavy instrumental parts to the summit of the mountain, which is about 6000 ft. above sea-level. For about half the distance of nine miles from Pasadena it became necessary to widen the bed of the mountain road from 3 ft. to 8 ft., and special motor trucks, with excess water capacity to guard against overheating the engines on the steep mountain grades, had to be provided. As an instance of the extensive demands on the transportation service, more than 650 tons of steel for the dome, some of the pieces being 24 ft. long, with a maximum weight of 4½ tons, were conveyed to the summit during the spring and summer of 1915. At a later stage, parts of the telescope weighing more than nine tons were safely transported. Fig. 1 shows a section of the telescope tube in course of transit.

All difficulties, however, appear to have been successively overcome, and with the aid of Prof. Hale's annual reports a general description of the instrument can now be given. First, with regard to the great mirror itself. The work of changing the spherical surface into a paraboloid occupied about a year, and for many months tests were made daily, both at the centre of curvature and at the principal focus. In general, the tests at the centre of curvature were found to be most useful in determining the total amount of parabolisation, and under the best conditions of air in the testing room it was possible to determine the radius of curvature of a zone within one-thousandth of an inch. The tests made at the focus, with the aid of the 60-in. flat, were invaluable for detecting and correcting slight zonal errors of surface, and by a combination of the two tests a higher degree of accuracy of surface was secured than would have been possible with either test alone. The parabolising was almost entirely performed by mechanical means, the final figuring by hand tools occupying less than twenty hours.

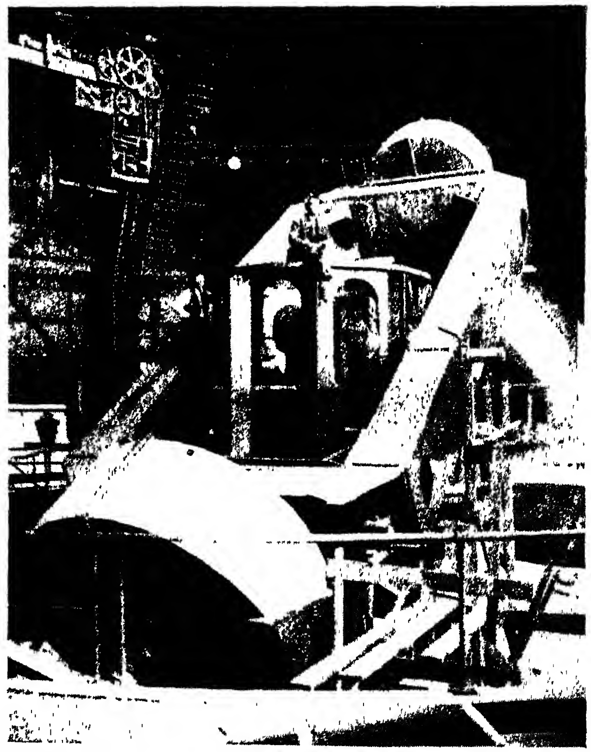

FIG. 2.—Partially erected mounting of 100-in. telescope, December, 1916. (The cutting of the teeth of the large worm gear has since been completed.)

After the final figuring, the Hartmann test was applied photographically, in order to check the

visual observations, and to provide a permanent record of the surface. The largest deviation of the observed from the theoretical focal length for any of the zones, except a small useless portion at the centre, was 0·14 mm., or about one part in 92,000.

The clear aperture of the mirror is nearly 101 in., and its focal length 42 ft. 3½ in.; the thickness at the edge is 12¾ in. The depth of the curve is about 1¼ in., and to some it may come as a surprise to learn that at the centre, where the difference is greatest, the depth of the finished paraboloid differs from that of the nearest spherical surface, which was that first given to the mirror, by only one-thousandth of an inch. The weight of the finished glass is a little more than four tons.

Although the area of the surface to be silvered was 8012 sq. in., this operation was accomplished without difficulty. About 150 gal. of distilled water and 32 oz. of silver nitrate were used in the entire process; 35 gal. of distilled water were required to fill the concavity, and to this 9 gal. of dilute silver solution and 9 gal. of dilute reducing solution were added. Deposition was complete in fifteen minutes.

Two convex mirrors have been prepared for use with the large mirror. One is 28¾ in. in diameter and more than 6½ in. thick; it has a radius of curvature of 28 ft. 10¾ in., and in Cassegrain combination will give an equivalent focal length of about 150 ft. The second convex mirror, to be used alternatively, is 25 in. in diameter, with a radius of curvature of about 22 ft. 11 in., giving an equivalent focal length of 251 ft. when in combination with the large mirror. We believe that arrangements have also been made for observations at the principal focus.

Few details of the mounting have been given in Prof. Hale's reports, but from the photograph reproduced in Fig. 2 it would seem that the "English equatorial" construction has been adopted. In this arrangement, the polar axis takes the form of a long rectangle, turning on an axis parallel to the longer sides, and the telescope tube is pivoted so as to turn on an axis parallel to the shorter sides. These two movements correspond respectively with motions of the telescope in Right Ascension and declination. The illustration shows the polar axis, with one of the sections of the tube in position. The tube is in four such sections, and has a diameter of 11 ft. The greater part of the pressure on the bearings, due to the immense weight of the moving parts, will be relieved by the flotation method first introduced by Dr. Common, and afterwards adopted for the 60-in. reflector at Mt. Wilson. Large circular floats, concentric with the polar axis, are provided for this purpose, one at the top and another at the bottom of the polar axis. As will be seen in Fig. 2, in the case of the lower float, each of these revolves in a nearly semicircular trough, and the intervening space will be filled with mercury. The driving clock is described as a highly perfected piece of mechanism. It required more than half a ton of bronze castings, and nearly 1½ tons of iron castings. It is provided with a driving weight of two tons.

The pier which supports the telescope measures 20 ft. by 45 ft. at the ground level, and is 33 ft. in height. The top consists of a circular concrete floor 11 in. thick and 54 ft. in diameter, being supported on the east and west sides by massive reinforced-concrete brackets extending outwards from the pier. A metal wall about 8 ft. high reaches from the edge of this floor to the level of the main steel floor of the building, and the joint between the two may be made air-tight by means of a water seal if found desirable. The pier itself is a remarkable structure. It is hollow in construction, with three heavily reinforced floors at different elevations. The first, at a distance of 16 ft. from the ground, is intended for a large water tank, to form a reservoir for a water circulation system enveloping the 100-in. mirror for the maintenance of constant

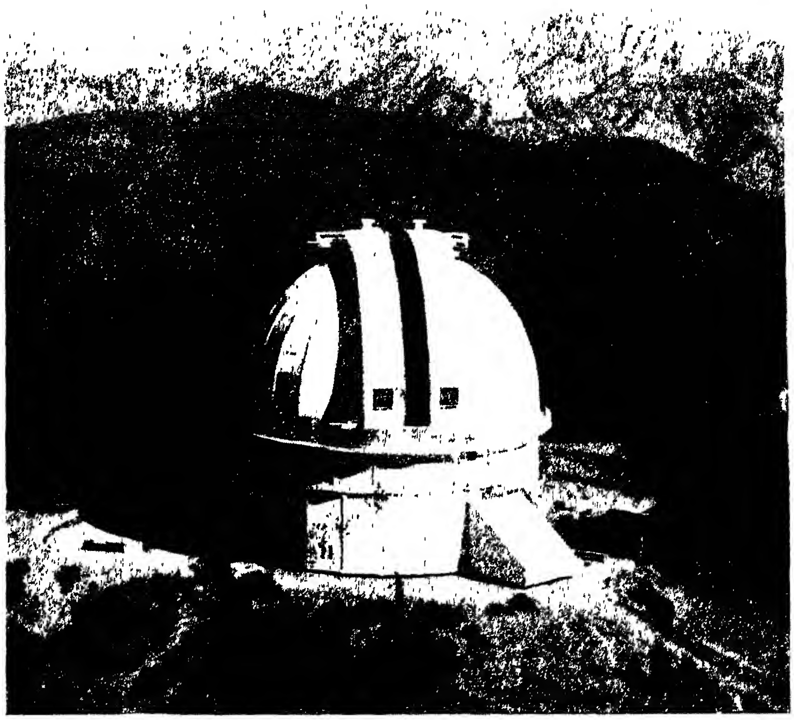

FIG. 3.—Completed dome for the 100-in. telescope, from the summit of the 150 ft. tower telescope.

temperature. At a height of 25 ft. is the floor which supports the driving clock and other parts of the mechanism, and on this floor also is a room designed for silvering the large mirror. Near the centre of the pier there is an opening, 14 ft. in diameter, which accommodates an electric elevator for handling the mirror.

On the south side of the pier is an extension, with a slope equal to the latitude, designed to carry large spectrographs when the instrument is

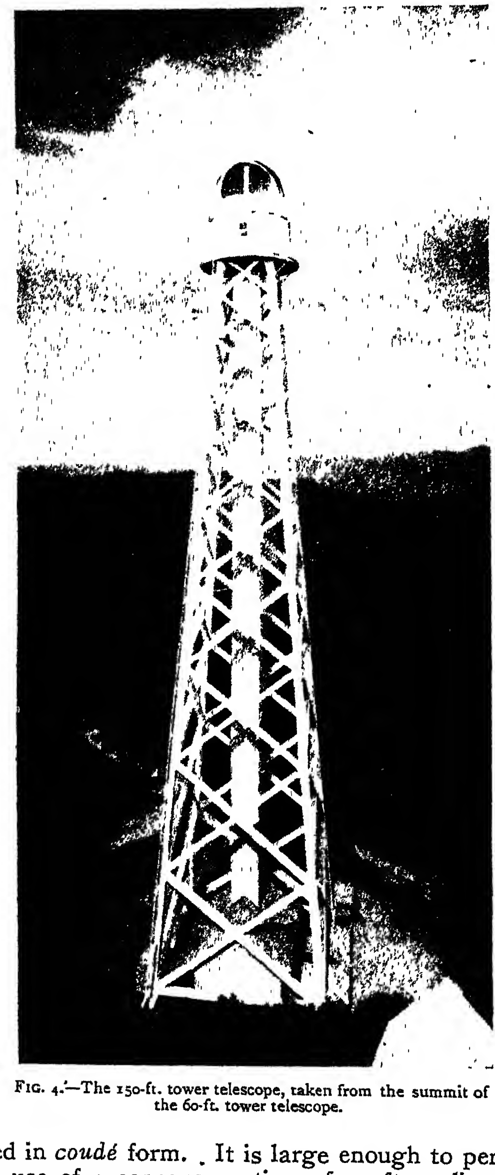

FIG. 4.—The 150-ft. tower telescope, taken from the summit of the 60-ft. tower telescope.

used in *coudé* form. It is large enough to permit the use of a concave grating of 21 ft. radius, or a plane-grating spectrograph of 30 ft. focal length, the light being received through an aperture in the lower portion of the polar axis.

The foundations for the building consist of forty concrete piers, each 6 ft. square at the base and 6 ft. high, arranged in two concentric rings. The sides consist of a steel framework, with an inner covering of sheet metal. The dome (Fig. 3) is 100 ft. in diameter, and is double-sheathed for protection of the telescope against great changes of temperature. An unusual permanent feature of the dome is a ten-ton travelling crane, which has also been utilised in the work of erection. The movements of the dome and telescope involve the use of no fewer than thirty-five electric motors, and the wiring proved to be a task of very considerable difficulty.

This brief account may suffice to give some conception of the immense amount of technical skill and foresight which has been called for in the design, construction, and housing of the new telescope. That the enterprise may be rewarded by a rich harvest of new discoveries will be the earnest hope of all who are interested in the progress of science.

Fig. 4 is from a recent photograph of the 150-ft. tower telescope of the Mt. Wilson observatory. In this instrument a beam of sunlight is reflected in a vertical direction by a cœlostat situated within the dome, and an image of the sun is formed at the base of the tower by an object glass near the summit. The special advantage of this arrangement arises from the fact that the greater part of the optical path is removed from the disturbing atmospheric conditions which are usually present at the ground level. The 75-ft. spectrograph, and other appliances used with the telescope, are contained in a deep pit beneath the tower, and constant temperature is easily maintained under these conditions. An important feature of the construction of the tower is that there is an inner framework which supports the optical parts, and an outer casing designed to protect the inner tower from disturbances by wind.

MATERNAL AND CHILD WELFARE.[1]

THE two handsome volumes before us, published under the auspices of the Carnegie United Kingdom Trust, are the most recent proof of the rapidly increasing attention and importance attaching to the subject of maternity and child welfare. The need for attention to the conditions of birth and the rearing of children has impressed itself upon the public in large measure in consequence of two considerations, the steady and persistent fall in the national birth-rate and the terrible loss of the most virile part of our population in the present great world-war.

The first volume, by Dr. Hope, the well-known medical officer of health of Liverpool, gives a general outline of the subject. In fifty-six pages he sketches the chief causes of maternal and infant mortality, the facts as to its national and local incidence, and the various organisations for the care of mothers and infants. Ante-natal care is considered, and the importance of further attention to the prevention of still-births is emphasised. The care of mothers during the lying-in period and after it, and the general subject of infant

[1] Report on the Physical Welfare of Mothers and Children. England and Wales. Vol. i., pp. xvi+454. By Dr. E. W. Hope. Vol. ii., pp. viii+190. By Dr. Janet M. Campbell. (The Carnegie United Kingdom Trust, 1917.)

welfare centres, are discussed, as are also the evil results of the artificial feeding of infants, and the need for greater care of illegitimate infants. There follow a series of beautifully executed statistical diagrams and illustrations of sanitary interest, which make this volume an admirably instructive picture-book. An abstract of legislation bearing on maternal and child welfare follows, and the remainder of the volume, from p. 113 to p. 427, is occupied by statistical summaries of maternal and child mortality in various towns in England and Wales, followed by comments and recommendations by the local medical officer of health, some of which are most useful.

The second volume is contributed by Dr. Janet Campbell, and deals with three subjects: midwives and midwifery, voluntary work for infant welfare, and play centres and playgrounds. The first of these sections contains an interesting sketch of the history of midwifery, and of the practice of midwifery at the present time in this and other countries. There follow useful suggestions for raising the standard of midwifery in England and Wales, under which heading are considered the questions of improved training, improved status, and improved financial position. The subject of midwifery practice in rural areas is specially discussed, and there is a short sketch of the important subject of maternity homes. There will be general agreement with the statement that, "even apart from real poverty, the accommodation in many reasonably clean and well-kept working-class homes is wholly inadequate for a well-conducted labour and lying-in." The parts dealing with voluntary work and play centres have much interest for those engaged in this important branch of child-welfare work, but need not be summarised here. This volume, like the one contributed by Dr. Hope, is lavishly illustrated by photographs, showing in this case the activities of baby welcomes, sewing classes, baby hospitals, infant nurseries, schools for mothers, etc.

A prefatory note is introduced on behalf of the Carnegie Trustees, in which, while expressing their appreciation of the importance of the subjects dealt with in the reports, they state that they do not commit themselves to the acceptance of the lines of policy or of the recommendations which have been submitted for their reconsideration. This was a necessary reservation, especially in view of the fact that it is understood that the Carnegie Trustees have under consideration the possible allocation of large sums of money to this or other objects of social importance. It may be hoped that they will discover means for utilising their resources to aid in the saving of maternal and infantile life and in the avoidance of unnecessary suffering of both mothers and infants, while stimulating local authorities to increase their present efforts to this end.

Dr. Hope, in his introductory remarks, points out three pressing necessities for which there is as yet no adequate provision, or prospect of making it. These are:—

(1) The provision of maternity homes.

(2) The establishment of welfare centres for pre-maternity and infancy and the need for greater care of illegitimate infants.

(3) Improvement in education in the various branches of the science of public health, and the encouragement of further research into the circumstances adversely affecting infancy and motherhood.

In a prefatory note contributed by Sir Arthur Newsholme, the principal medical officer of the Local Government Board, the first of these points is particularly emphasised. He points out that, although much improvement has occurred, it still remains true that on an average in England and Wales there occur week by week sixty-seven deaths of mothers as the result of pregnancy and parturition, and that a very large proportion of these are avoidable, as shown by the fact that in some areas the death-rate in connection with child-bearing is two, or even three, times as high as in others. The same is true of child mortality. In some towns the death-rate among infants under a month old is two or three times as high as in others; and the chief burden of these reports is said in this prefatory note to be

> the immediate need for further national effort to reduce sickness and mortality among child-bearing mothers and the closely related mortality among infants before birth and in the first month after live-birth.

This article may be closed by the quotation of a further sentence from the prefatory note by the medical officer of the Local Government Board:—

> Maternity homes are urgently needed, and I know of no social work so likely as the provision of such maternity homes to give immediate results in saving maternal and child life, in diminishing chronic invalidism of mothers, and in enhancing the national welfare.

We hope that these reports will have a wide circulation and will reach a wider public than the official reports on the same subject which have already been issued.

NOTES.

THE Treasury has informed the British Science Guild that the issue of the *Kew Bulletin* is to be continued subject to the omission of certain classes of information. The announcement was made in the House of Commons on July 4, when Sir William Beale, a member of the executive committee of the Guild, asked the Secretary to the Treasury "whether the question of continuing the printing and publishing of the *Kew Bulletin* had been reconsidered; and whether he can now give an assurance that this publication, or at least that part of it which is devoted to the spread of useful knowledge of plant culture and plant products throughout the Empire, will shortly be resumed?" Mr. Stanley Baldwin's reply was: "I am informed that the question of the suspension of the issue of the *Kew Bulletin* was considered by the Select Committee on Publication and Debates Reports last week, and that it was decided to recommend that the *Bulletin* should be continued, but with due regard to economy. Subject to the omission, therefore, of certain classes of information which, though doubtless of scientific interest, can, it is thought, be postponed without detriment to the welfare of the State, the publication of the *Bulletin* will be resumed." In reply to a question asked by

Viscount Bryce in the House of Lords on July 10, the Duke of Marlborough said that the editor would be entitled to consider what was essential and what could properly be omitted from the *Bulletin*.

IN view of the cancellation of the annual meeting of the British Association, it has been necessary to make special arrangements for carrying on the Association's current work. Meetings of the organising committees of the various sections, the delegates of corresponding societies, the committee of recommendations, and the general committee have therefore been held. It has been decided to continue Sir Arthur Evans in the presidency for another year, while the Hon. Sir C. A. Parsons, who would have presided over this year's meeting, will do so at the meeting which it is hoped will take place as arranged at Cardiff next year. The meeting this year would have been at Bournemouth, and that borough has repeated its invitation, which has been accepted, for 1919. Grants amounting to 286*l*. were made in aid of such researches as were regarded as essential to carry on, having regard to present conditions. The new members of the council of the Association are Dr. E. F. Armstrong, Mr. J. H. Jeans, Prof. A. Keith, Prof. W. H. Perkin, and Mr. W. Whitaker.

Le Temps of June 29 contains a full report of the discourse delivered by M. Alfred Capus on his election to the French Academy in the place vacant by the death of Henri Poincaré. The election of a man of letters to fill the place of a man of science might strike some people as strange, but M. Capus remarks that in France knowledge has never been reserved for some few "mandarins" any more than it has required an obscure language and esoteric formulæ, and recalled the example of Descartes. In fact, since the seventeenth century the education of the French middle class has always kept up both the scientific and the literary tendency. It is the custom for such a discourse to be devoted to the work and life of the particular predecessor, and so Poincaré's works, and particularly his books, "La Science et l'Hypothèse" and "La Valeur de la Science," are described with a light touch that, owing perhaps to its being a national characteristic, is not unlike the touch of Poincaré himself when he was dealing with subjects with which he was not very well acquainted.

IT was reported in the *Daily Chronicle* of June 20 that the Duchess of Somerset had stated that "as a result of gunfire sixty kinds of migratory birds had ceased to visit Britain." This report was so definite and remarkable that we communicated with her Grace, who informs us that what she stated was that her gardeners had said that this year there was only one bird for every sixty which were here last year, "from the effects of cold weather, etc." As many general statements have been made recently referring to the alleged absence of migratory birds in consequence of heavy gunfire and a prolonged winter, we communicated with Dr. W. Eagle Clarke, keeper of the Natural History Department of the Royal Scottish Museum, Edinburgh, and a leading authority upon bird migration. Dr. Clarke says: "Not a single species of regular migratory bird has been absent from Britain since the war broke out. I am familiar with the whole of the data, from all parts of Scotland, relating to our seasonal bird-visitors for the past twenty-five years, and am able to state that this summer all our regular spring migrants are with us in their usual abundance. I have no information relating to the effect of gunfire on bird migration other than that so far as our islands are concerned it has had no influence whatever on the comings and goings of our feathered visitors."

WHEN a bomb is dropped from a moving aeroplane the point at which it strikes the earth depends primarily on its altitude above and speed with respect to the earth's surface, and to a smaller extent on the speed of the wind and the mass and surface of the bomb. In order to allow the aviator to drop his bomb on a given object, the most recent German aeroplanes are provided with an instrument made by Goerz which consists of a telescope kept vertical by means of a bubble of air in the eyepiece. By means of a movable prism below the objective the observer can adjust his instrument so that he sees through it objects at a given angle ahead or in the rear. The instrument is generally used when the aeroplane is moving against the wind. From the aneroid reading of the height of the aeroplane and the time taken to get vertically over an object seen previously 22·5° ahead, the speed of the aeroplane is known. The speed of the engine gives the speed of the aeroplane through the air, so that the speed of the air is known, and for a given bomb the angle at which the line of sight of the instrument must be set ahead in order that a bomb released when the object is seen in the telescope may strike that object is also known. Variations of direction of flight of the aeroplane and of strength and direction of the wind cause errors which are to some extent eliminated by further devices which will be found described in *La Nature* for June 19.

AN interesting article appears in the current number of the *Fortnightly Review* under the title "The Civil Aerial Transport Committee: A Milestone in the History of Flight." The question of the use of aircraft for commercial purposes, and especially for mail services, is treated in a very clear and practical manner. The authors of the article—Mr. C. Grahame-White and Mr. Harry Harper—consider that our present knowledge of aeronautics is sufficient to enable a machine carrying one ton of mails at 100 miles per hour to be built with ease. It is pointed out that the weather would have less effect on an aerial mail than is sometimes supposed, as a heavy machine is less susceptible to gusts than the earlier light and under-powered aeroplanes. A machine travelling at 200 miles per hour is pictured as a future possibility, but this is certainly out of the question with present-day engines. Future research will doubtless produce lighter petrol motors, but it remains to be seen whether Mr. Grahame-White's suggested gas turbine, with a weight of half a pound per horse-power, will ever become a practical proposition If such an engine were ever produced, the future of commercial aviation would indeed be bright with promise. The question of landing grounds is discussed at some length, and it is pointed out that the establishment of an aerial mail must be preceded by the setting out of a series of good landing grounds at short intervals along the route. This can, of course, be easily done, and the provision of suitable ground signs by day and night to enable the aviators to locate themselves should offer no difficulties of practical solution. Much stress is laid on the necessity of spending considerable sums on scientific research to elucidate any technical questions that may arise, in order that the establishment of a commercial air service may be attended with as few accidents and as little loss of life as possible.

THE committee appointed by the Institute of Bankers to consider the question of the adoption of a decimal coinage and the metric system of weights and measures has issued its report. As regards weights and measures, the committee is of opinion that the existing system in this country is an obstacle in the way of the extension of our foreign trade, especially of our export trade, and as a first step

towards the introduction of the metric system it recommends the adoption of a decimal coinage. Retaining the pound sterling as the unit of value, the committee proposes to divide this into a thousand parts, called "mils." The gold coinage would then consist of a sovereign of 1000 mils and a half-sovereign of 500 mils, while the silver coinage would comprise pieces of 200, 100, 50, and 25 mils, of precisely the same values as existing coins. The crown and half-crown would drop out, and the bronze coinage would include pieces of 4, 2, and 1 mils. The withdrawal of the threepenny-piece is also recommended, this being replaced by a 10-mil piece having a scalloped edge, and made of nickel or some other similar metal or alloy. The committee is confident that as regards the gold and silver coinage the transition would not present any serious difficulties. The changes in the values of the bronze coins might, it is thought, cause some disturbance in the small everyday monetary transactions, but this would be slight, as the proposed pieces would be only about 4 per cent. less in value than the present bronze coins. Although the committee does not advise that the change should be made until some time after the declaration of peace, it strongly urges that the necessary legislative steps should be taken without delay.

PROF. C. BASKERVILLE, professor of chemistry in the College of the City of New York, New York City, has been appointed by the Ramsay Memorial Committee, on the suggestion of the American Ambassador, representative and corresponding member of the committee in the United States of America. Prof. Baskerville will take the necessary steps for forming a committee in the United States and for receiving subscriptions to the fund from Americans. Americans wishing to subscribe to the Ramsay Memorial Fund can send their subscriptions either to Prof. C. Baskerville or to the Rt. Hon. Lord Glenconner, honorary treasurer of the Ramsay Memorial Fund, University College, London, W.C.1.

DURING the past two years a number of cases of anthrax infection due to the use of infected shaving brushes has been recorded (nineteen cases among civilians and forty-six among soldiers). The matter has been investigated by Dr. Coutts and others, and a report on the subject has just been issued by the Local Government Board (New Series, No. 112). The anthrax infection assumed the external form, or malignant pustule. The first case was detected by Dr. Elworthy, pathologist to the West London Hospital, who proved the presence of virulent anthrax spores in the shaving brush used by the patient, and also in other unused brushes of the same pattern purchased at the shop from which the original brush was obtained. Another case of anthrax occurring about the same time was also traced to the use of an infected shaving brush purchased from a different shop. On tracing the origin of the brushes, it was found that they all came from one wholesale dealer, and were manufactured in a single factory. Inquiries made on behalf of the Board showed that the hair used in making these brushes consisted in great part of Chinese horsehair, and had not been disinfected before use. The remaining unmanufactured hair was found to be largely infected with anthrax spores. The hair in question had been invoiced as "goat's hair," which does not come under the Home Office Regulations (dealing with disinfection of Chinese horsehair), and hence had not been disinfected. In three further cases shaving brushes infected with anthrax were traced to manufacturers other than the one concerned in the first cases. In addition, four further cases were traced to brushes of foreign manufacture—Canada, New York, and Japan. The Board has under consideration what administrative action is required to secure that hair used in the manufacture of shaving brushes in this country is satisfactorily sterilised before the brushes are manufactured.

MR. C. W. HOBSON (St. James's Square, Manchester) has forwarded to us a pamphlet containing a scheme whereby the public conscience might be aroused to the significance of the loss of infant lives and means of prevention made widely known. The education of the mother in infant welfare will take a primary place in any scheme of prevention, but how this is to be effected is a difficult problem. The suggestion is that use should be made of the public Press, and that matter dealing with the care of the infant should be inserted in the advertisement columns as persistently and frequently as that directing attention to the merits of a particular soap or infants' food. In this way, it is claimed, it would meet the eye of the young mother whenever she takes up a newspaper.

LARGELY owing to the example of the late Prof. Skeat, the old unscientific treatment of local place-names has been superseded by more accurate methods. People ignorant of Anglo-Saxon and of the laws of philology had no hesitation in theorising on English place-names in a way which would not have been tolerated by classical scholars in the case of Greece or Rome. Mr. St. Clair Baddeley, who has already published an excellent manual of the place-names of Gloucestershire, has now extended his survey to those of Herefordshire in a paper published in vol. xxxix. of the Transactions of the Bristol and Gloucestershire Archæological Society. He points out that Herefordshire place-names present a particularly difficult problem, the county comprising lands which were once the battlefield between Goidel and Brython, between Roman, Silurian, and Brython, and finally between Mercian, West Saxon, and Welsh. All these races have left their traces in the local nomenclature, and the task of disentangling these varied elements has been increased by the intervention of the folk etymologist, of whose work curious examples are given. The bulk of the paper is devoted to an elaborate glossary, which will interest the historian as well as the philologist.

STUDENTS of the history of natural science may read with interest and profit Prof. R. L. Moodie's article on "The Sources of Anatomical Literature" in the *American Naturalist* for April (vol. li., No. 604). The author reckons 736 anatomists of eminence, among whom 78 were Italian, 95 British and Irish, 36 American, 127 French, and 240 German.

IN the *Journal of Genetics* (vol. vi., No. 3) Miss Edith R. Saunders continues her studies of "'Doubleness' in Flowers," dealing with the genera Meconopsis, Althæa, and Dianthus. Double flowers are "mostly female, owing to complete petalody of the androecium"; these, fertilised with pollen from incompletely double flowers, give double offspring. "The relation of single to double is evidently that of dominant to recessive, being thus the reverse of that which obtains in the carnation."

THE Journal of the Washington Academy of Sciences (vol. viii., No. 7) contains a summary of Dr. L. O. Howard's presidential address on "The Carriage of Disease by Insects." It is now known that 226 different disease organisms are carried by insects to man or animals, 282 species of insect-carriers being concerned. Dr. Howard regards the transmission of pellagra by Simulium as definitely disproved, and considers it unlikely that infantile paralysis is an insect-borne disease.

THE life-history of *Diapus furtivus*, a platypod beetle that bores in the sal tree in northern India, as described by Mr. C. F. C. Beeson (Indian Forest Records, vol. vi., part 1) is of much interest from the ecological, as well as from the economic, point of view. The female beetle constructs the galleries in the timber wherein the insects breed, and transports and cultivates the fungus ("ambrosia") which forms the principal food of the larvæ. The male takes no share in this work, but he is useful as a scavenger, as he collects particles of wood fibre and excrement, pushes them backwards to the end of the entrance tunnel, and expels them with a sharp jerk that entails considerable muscular effort.

THAT noxious weeds are spread by birds is well known. But a new method of dispersal is described by Mr. Charles Barnard in the *Emu* for April, where he reviews the devastation caused among the birds of Queensland by the terrible drought of 1902. Many species escaped extermination by migrating to the coast. Among these was the bustard or "plain turkey" (*Eupodotis australis*). In the skin, and even embedded in the flesh, of a specimen killed in its place of refuge the author found numbers of the "spears" of the dreaded "spear-grass." Hundreds of birds, he remarks, must thus have been infected, and these, sooner or later, will find their way back to the Western plains to scatter this scourge over the sheep country.

THE skeleton of an adult female piked whale (*Balaenoptera acutorostrata*) stranded at Crail in 1913 is carefully described by Prof. M'Intosh in the *Journal of Zoological Research* for May. Some interesting changes in the form of the skull during post-natal development are brought out by comparison between this specimen and the skull of a young male of about 9 ft. in length. Perhaps the most noteworthy feature in this description is the fact that a curious "sesamoid" bone was found "in a tendon over the third and fourth cervicals," measuring about 3⅞ in. long. So far, we believe, this is the first time that such a structure has been described. We venture to think that still further value would have been added to this memoir if the total length of the animal had been given, and if a comparison therewith had been made between this skeleton and that of Rudolphi's rorqual.

APROPOS of the construction of fleets of wooden ships in the United States, designed to defeat the German submarine menace, Mr. H. F. Weiss, in a June issue of the *Scientific American*, gives a brief summary of the main facts in regard to the life-histories of the wood-boring "ship-worms" and "wood-lice." By far the most destructive of these is the worm-like teredo. The rate at which wood exposed to its attacks is destroyed is remarkable. Sound pitch-pine piling, he remarks, driven in certain harbours on the Texas coast, were destroyed in twenty-nine days. The author utters a word of warning against the use of creosoted wood as a deterrent against its ravages, for this in no wise confers protection, while it may render cargoes of food-stuffs uneatable owing to the fumes from the wood. Copper sheathing and copper paint are the only possible agents to defeat such ravages. Compared with the teredo, the damage done by the "piddock" is negligible. Of the "wood-lice," the species known as the "gribble" is almost as much to be feared as the teredo, but it works more slowly.

THE *West Indian Bulletin* (vol. xvi., No. 2, 1917) contains several papers of importance, one of particular interest being by Sir Francis Watts on "The Recovery of Sugar at Gunthorpes Factory, Antigua, during the Years 1905–16." The contents of sucrose and fibre per hundred parts of cane are given for each year, and the tables show an unusually large amount of fibre, which has tended to increase in recent years, while the sucrose content has steadily fallen from 15·3 in 1905 to 12·5 in 1916. No adequate explanation is forthcoming, since dry seasons do not appear to affect the proportions in any way. When it is realised that a difference of one per cent. in sucrose content, such as between 13·5 and 14·5, would mean an increase in output of about 1000 tons from a factory making 14,000 tons of sugar, equal to a gain of 1000*l*. on each 1000 tons of factory output, it will be recognised that there is a considerable field open for careful scientific research on both chemical and botanical lines.

IN the *American Journal of Science* for April (vol. xliii., p. 322) Mr. G. P. Merrill records further observations on the occurrence of calcium phosphate in meteorites, and places the crystals under francolite. Unlike normal apatite in igneous rocks, they crystallise out in the later stages of consolidation; but the author points out that this may be due to unknown meteoritic conditions.

MR. S. TABER'S experiments on growing crystals, and his conclusion that growth against external pressure takes place only in contact with a supersaturated solution, were referred to in NATURE, vol. xcvii., p. 470. Mr. E. T. Long (*Amer. Journ. Sci.*, vol. xliii., p. 289) has now allowed hot brine prepared from table salt to cool while running through a rubber finger-stall, with a small perforation at its narrow end, and finds that the crystals not only expand the rubber, but even produce punctures. The crystals ceased to grow when the supersaturated solution was removed from their surface.

To *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, No. 5, for 1915, the publication of which has been inevitably delayed by the present war, Capt. G. G. E. Mauger contributes an interesting paper under the title of "Quelques considérations sur les jeux en Chine et leur développement synchronique avec celui de l'empire chinois." This will be of special value to those engaged in the study of the origin of chess and other games, such as draughts, and those in which dice are used.

A GLOSSARY of names in the Austrian coastlands of the Adriatic (*Prontuario dei nomi locali della Venezia Giulio*) has just been published by the Royal Italian Geographical Society (vol. xv., part ii., Memoire). It follows at an interval of a few months the glossary of the Adige region previously noted in NATURE. This glossary contains all the names, arranged in alphabetical order, on the Austrian map of the coastlands on a scale of 1 : 75,000. After each is given the Italian equivalent, and in many cases the Slav form. The Italian Geographical Society is to be congratulated on its useful publication and on its sanguine anticipation of the return of these lands to Italy.

THE statistics of Italian earthquakes during the twenty years 1891–1910 are examined by Dr. A. Cavasino in a recent paper (*Boll. Soc. Sismol. Ital.*, vol. xx., for 1916, pp. 9–31). The total number of earthquakes recorded is 5922, giving an average annual number of 296. The Calabrian earthquake of 1905 was followed by a train of 396 after-shocks, the Messina earthquake of 1908 by 1227. It is generally supposed that the greater frequency of earthquakes at night is apparent and due to the quiet of the midnight hours. Dr. Cavasino shows that this is not the case for Italian earthquakes by considering only shocks of such intensity that they could not escape notice at any hour of the day. Of these, 865 occurred during the twelve night hours, and 638 during the day hours.

AN interesting addition to the history of the invention of the achromatic telescope is made by Mr. R. B. Prosser in an article in the June number of *Notes and Queries*. Although in 1758 John Dollond was awarded the Copley medal of the Royal Society for the invention of the achromatic telescope, and is still called the inventor of the instrument in the 1912 edition of the Records of the Royal Society, it has been known for some time that the crown-flint objective had been invented previously by Chester Moor Hall, a barrister, of Essex, and the relative positions of Dollond and Hall are set forth by Miss A. M. Clerke in her biographies of the two in the "Dictionary of National Biography," and by Mr. H. D. Taylor in his article on the telescope in the "Encyclopædia Britannica." The new facts brought forward by Mr. Prosser are contained in a petition of 1764, from thirty-five opticians of London and Westminster, praying for the revocation of the patent granted to John Dollond for achromatic lenses, on the ground that such lenses were made by George Bast, optician, of Fleet Ditch, to the specification of Hall in 1733, that they were on sale by Ayscough, optician, in Ludgate Hill, and that Robert Raw, optician, of Coldbath Fields, told Dollond of them in 1755. This petition was apparently unsuccessful, for in 1766, after the death of John Dollond, his son Peter obtained a verdict against James Champneys, optician, of Cornhill, for infringement of his father's patent, and was awarded 204*l*. damages, the judge, Lord Camden, holding that Hall had not adequately "published" his invention.

A JOINT meeting of the Faraday Society and the Society of Glass Technology was held in the Department of Applied Science at the University of Sheffield on June 20, under the chairmanship of Mr. W. F. Wood. The Vice-Chancellor of the University, Dr. W. Ripper, opened the proceedings with a few words of welcome. The first paper was contributed by Prof. Fearnsides on "The Resources of Refractory Materials Available for Glass Manufacture." Refractories are to be found in different geological formations, but it is noteworthy that many of the most used substances are in the vicinity of Coal Measures. The occurrence and relative importance of various ganister and fireclay beds were discussed, and their positions indicated on a large-scale map. The resources of refractories in the West Riding of Yorkshire received particular mention, special emphasis being laid on the silica from Meltham, near Huddersfield, ganister from the neighbourhood of Sheffield, and fireclay from the Halifax district. Mr. Davidson, of the Glass Technology Department of the University of Sheffield, followed with a paper on analyses of clays and their plasticity. He also dealt with the contraction due to drying and firing. Most clays contract between 5 and 6 per cent. in drying. Firing was done at 1000° C., when a linear contraction of from 0·5 to 1 per cent. was noted, and afterwards at 1450° C., when the contraction varied from 8·75 to 11 per cent. in the majority of cases. Dr. Rosenhain spoke on the desiderata of a good refractory, and Dr. Boswell on the need of further investigation of the behaviour of pot clays, in which he hoped the glass manufacturers would take part. Mr. Spiers, the secretary of the Faraday Society, appealed to glass manufacturers to make known their difficulties regarding refractories. The main object of the Faraday Society was to concentrate on these difficulties, and up to the present considerable success had been achieved.

A CONCRETE dam of considerable magnitude—the loftiest, in fact, in the world—has recently been constructed near Boise, Idaho, U.S.A. *Engineering* of June 29 gives the following particulars of the work. The dam, which is known as the Arrowrock Dam, is 348½ ft. high (98 ft. higher than the celebrated Flatiron Building in New York City), 140 ft. thick at the bottom, and 1100 ft. long at the crest. It cost 5,000,000 dollars to construct, and forms part of a scheme involving an outlay of 12,000,000 dollars. In the execution of the work, 683,000 cu. yds. of spoil were removed, and 610,000 cu. yds. of concrete deposited, with 1,350,000 lb. of steel reinforcement and 1800 tons of structural steel. The object of the dam is to provide a store of water for irrigation purposes to serve an area of some 240,000 acres. The reservoirs will accommodate 240,000 acre-feet, and will be fed from the surplus flow of the Boisé River, in the late winter and the early spring, when the river is in torrent. An interesting feature of the work is the means provided for dealing with 3,000,000,000 cu. ft. of merchantable timber, located in the basin of the river above the dam, for which the river forms the only practicable exit. A cable lift is installed for handling the logs and depositing them on a concrete deck at the top of the dam, whence they are transferred by spiked rolls to a chain, which conveys them to a gravity shoot, where they slide down into the river below. It is stated that the dam has already amply justified its existence by saving the crops on 100,000 acres, and that this economy alone would be almost sufficient to defray the total cost of the work.

IN a paper on "Some Compounds of Boron, Oxygen, and Hydrogen" (published by Messrs. H. K. Lewis and Co.) Dr. Travers, with Messrs. N. M. Gupta and R. C. Ray, describes a series of compounds prepared by the action of water and of ammonia on magnesium boride, B_2Mg_3. These compounds, examined mainly in aqueous solution, include a dioxide, B_2O_2, an oxide, B_4O_3, and a sub-oxide, possibly B_2O, as well as a series of borohydrates, $B_x(H_2O)_y$, analogous with the carbohydrates.

OUR ASTRONOMICAL COLUMN.

THE NEBULÆ AND STELLAR EVOLUTION.—A full report of Prof. W. W. Campbell's address as retiring president of the American Association for the Advancement of Science is given in *Science* (vol. xlv., No. 1169). The subject chosen was "The Nebulæ," and, besides giving an interesting account of the development of our knowledge of these objects, with an abundance of fine illustrations, Prof. Campbell clearly stated his views as to the place of the nebulæ in the cosmical scheme. As to the spiral nebulæ, Prof. Campbell considers the hypothesis that they are independent stellar systems, or "external universes," to be in best harmony with the known facts. As regards the gaseous nebulæ, while a strong case can be made out for the evolution of planetary nebulæ into stars, it cannot safely be concluded that all stars have been developed from nebulæ of this class; their comparative scarcity and their relatively high velocities are decidedly against such a conclusion. A much stronger case can be made out for the hypothesis that the stars in general have evolved from irregular nebulæ, which have spectra identical with those of the planetaries. These nebulæ are closely related spectroscopically to the bright-line stars, and these again to the early class B stars, and from thence the sequence can be traced through the Sirian and solar types to the red stars. This is regarded by Prof. Campbell as the most probable course of stellar evolution. Facts as to the distribution of nebulæ and of the different classes of stars seem to him to be opposed to the view that some of the red stars may be at an early stage of evolution.

THE TEMPERATURE OF SPACE.—In a communication to the *Astrophysical Journal*, vol. xlv., p. 269, Prof. Fabry arrives at the interesting conclusion that while the idea of temperature at a point in free space has no meaning in itself, the temperature of a testing body may vary enormously according to its absorptive properties. A testing body having a black surface is of no special theoretical interest, but a body with selective absorption may attain a temperature much lower or much higher than that of a black body, according to the wave-length of its absorption band. If the body be very absorbent for long wave-lengths, and only slightly so for short wave-lengths, it will radiate like a black body, but will absorb scarcely anything, and its temperature of equilibrium will be very low. On the other hand, if the body strongly absorbs the short wave-lengths, and has zero absorptive power (and consequently zero emissive power) for long wave-lengths, its temperature will continue to rise until it becomes capable of emitting the corresponding short wave-lengths. At the earth's distance from the sun, a body with a single absorption band at $0{\cdot}4\,\mu$ would reach a temperature of about 1980°—nearly the melting point of platinum—by simple exposure to the rays of the sun; while a black body under the same conditions would only reach 280°. Prof. Fabry considers it not impossible that some action of this kind may be effective in maintaining gaseous masses in space at a high temperature, and he suggests that the luminosity of the tails of comets may be a purely thermal radiation due to the very high temperature produced by a slight selective absorption exerted upon the solar rays.

RADIAL VELOCITIES OF FIVE CEPHEID VARIABLES.—Investigations of the radial velocities of the southern Cepheid variables, S Muscæ, R Tri. Aust., S Tri. Aust., S Normæ, and RV Scorpii, have been made by G. F. Paddock (Lick Obs. Bulletin, No. 294). Variations in the apparent radial velocity were found in each case, the amplitudes being 33, 33, 28, 24, and 32 km. respectively. It is concluded that these Cepheid variables possess the distinguishing characteristics found in others of their class, namely, considerable eccentricity; similar order of amplitude of velocity, 20 to 40 km. for the majority; greatest negative velocity occurring a few tenths of a day later than maximum light; and close correspondence between times of maximum velocity and minimum light.

THE AUSTRALIAN WATER PROBLEM.[1]

THE great island-continent of Australia admittedly possesses a wonderful store of natural wealth which only needs exploitation to render the country one of the richest and most productive of British territories; and yet development proceeds but slowly. The agricultural and pastoral industries, for example, have barely taken root; out of a possible 200,000,000 acres only 12,500,000 are producing wheat at the present time. The population, too, is the scantiest of any of the civilised countries of the world, being only 1·7 to the square mile. The reason for this backwardness perhaps is not far to seek. Notwithstanding its remarkable endowments, the country is beset by a very serious disability. Vast tracts of it are desert waste, and, with the exception of the coast-line, the whole is more or less afflicted by visitations of drought.

So vital a defect calls for energetic measures, and much has already been done to promote artificial irrigation wherever practicable. Fortunately, the arid tracts are not without compensating features. Various basins have been traced where water can be obtained by sinking artesian wells. In the year 1915, according to the report of the Royal Dominions Commission, there were no fewer than 3470 of such borings, ranging in depth down to 5000 ft. From some of them the outflow was remarkable. One case is cited of a daily flow of no less than 4,500,000 gallons.

The two papers before us deal with the practical steps taken to obtain supplies in Western Australia, and, more particularly, in that portion of it which centres in the mining district of Coolgardie and Kalgoorlie. "Speaking generally," says Mr. O'Brien, "the country north of 29° S. lat. contains fresh water at fairly shallow depths, while south of that latitude the water is salt." Towns and industries to the north of the line are supplied with water from groups of wells spaced 10 to 20 chains apart, round a central pumping-station. In the southern section water fit for human consumption can be obtained only by conservation of the rainfall before infiltration. The underground water contains sodium chloride and other salts, in proportions from ½ oz. to 12 oz. to the gallon, and is, accordingly, suitable only for ore-washing and similar purposes.

The fresh-water wells range in depth from 50 ft. to 120 ft., and cost from 3*l*. to 4*l*. 10*s*. per foot of depth. A considerable number have been constructed by the Water Supply Department, at intervals of ten to fifteen miles along the roads which have been cleared for several thousand miles through the mining district. The surface of the country is undulating, ranging in altitude from 1200 ft. to 1500 ft. Its formation is mostly red sandy loam and granitic sand, overlying laterite and conglomerate.

Conservation of rain-water is effected with the aid of storage-tanks, and when these are appropriately situated in the scattered outcrops of solid granite (some of 300 acres in extent) as much as 95 per cent. of the first inch of rain has been conserved, and from rains quickly following, 100 per cent. In other catchment areas, when the surface is clay loam, conglomerate, etc., the natural water-courses are utilised so far as possible for collection, the beds being rectified wherever necessary to eliminate scour. In order that the water may quickly reach the leading drains, a network of plough furrows is often driven in the adjacent land.

Tanks vary in capacity from 1,000,000 to 3,000,000 gallons. They may be simple excavations, or pits, in watertight ground; in other cases they are formed with clay puddle embankments and beds, or are lined with concrete or asphalt. The concrete tanks did not prove a success, as when no rain fell for a considerable period serious cracking developed in the concrete, in spite of a roofing of corrugated iron. The asphalt tanks, constructed under conditions described in the paper, have satisfactorily fulfilled all requirements. There are a few instances of iron tanks of 10,000 to 20,000 gallons capacity.

The towns of Coolgardie and Kalgoorlie differ from other populous centres in that their water-supply is obtained from a joint source in the Darling Range, at a mean distance of 340 miles. The Helena reservoir is fed from a catchment area of 569 square miles, and the water so obtained is pumped through a pipe-line of 30-in. diameter steel piping to its destination. The catchment area lies in hilly country, rarely, however, exceeding an elevation of 1100 ft., and much intersected by narrow and steep-sided valleys. The surface is heavily timbered and cumbered with undergrowth. The soil is an ironstone gravel overlying

[1] "Water Supply in the Interior of Western Australia." By P. V. O'Brien. "The Coolgardie Water Supply, Western Australia." By P. V. O'Brien and J. Parr. Papers read before the Institution of Civil Engineers, London, on April 3.

decomposed granite: solid granite is reached at a depth of 20 ft. These features, together with a light intermittent rainfall, help to account for the small yield of the reservoir, ranging as it does from a few hundred million to a little more than 20,000,000,000 gallons per annum—not more than about $7\frac{1}{2}$ per cent. of the rainfall. The consumption of water in the districts supplied has increased from an average of 600,000 gallons per day in 1903 to about 2,000,000 gallons per day at the present time.

The success of the measures in course of adoption for the treatment of this grave difficulty of water-supply in Australia will be followed with interest, not merely by engineers and geologists, but by all who have at heart the development of the Empire, and its widespread capabilities for usefulness to mankind.

BRYSSON CUNNINGHAM.

THE REPORT OF THE BOARD OF EDUCATION, 1915–16.

THE report of the Board of Education for the year 1915–16 is a document to which, in the present state of public expectation, more than usual interest will be attached. It is naturally concerned in large measure with the work and problems of elementary education, upon which by far the larger proportion of the public funds are, by the very circumstances of the case, expended. But it is now fairly generally admitted that we cannot have a sound solution of the problems of education, or raise an educational edifice worthy of the name, or secure the right type of educated electorate, or place education upon its highest plane, unless we make much more adequate provision for the training of the great mass of the people.

A grave responsibility now rests upon the nation, in view of the devastating effects of the war, to provide with the utmost fullness possible for all its children the means of physical, mental, and moral health, and especially to secure ample educational opportunities for the worthy, no matter of what class. The claims of the war during the year under review upon the schools, upon the teaching staffs, even upon the pupils themselves in response to industrial and agricultural demands, have increased in intensity and with unfortunate results, since many school buildings have been closed either for the billeting of troops or for use as hospitals; the male teaching staffs have been seriously depleted; the classes have necessarily been enlarged, to the grave disadvantage of the pupils; and in many other ways the work of education has been impeded. There has been a serious decrease compared with 1915 of nearly 26,000 pupils of twelve years of age and upwards in the public elementary schools, due to the large number who have passed into employment.

The question of the supply of male teachers has become grave, even apart from the exigencies of the war, due in large measure to the inadequate salaries paid and to the poor prospects offered. In the year 1916, on August 1, the number of boy entrants to the teaching profession in England and Wales was 1063, of girls 5228, or a total of 6291; but the real annual demand for entrants, even under normal conditions, is 9000, including men and women. Unless this grave deficiency can be met by satisfactory measures there can be neither any increase in the length of the school life nor reduction in the size of classes, and it will, moreover, gravely imperil the level of efficiency in the schools reached before the war. The number of men students in the training colleges has fallen from 4242 to about 1500, and nearly 4000 men have joined the Army direct from them. It is now proposed, in order to increase the supply of candidates, to modify the requirements of the bursar system in the direction of the pupil-teacher methods of former days.

The work of the secondary schools, like that of the elementary schools, has suffered much by reason of the war. The number of schools now recognised as efficient by the Board is 1178, educating some 231,000 pupils, a vast advance upon days prior to 1902. Of this number about 9000 were displaced in 1916 by military or hospital occupation of school premises, and other provision far less adequate was made for them. The male staff of the secondary schools has also suffered much. Upwards of 2600 men have joined the Services since the beginning of the war up to October 31, 1916. Praiseworthy efforts have been made by the local education authorities and by the teachers of all grades to meet the untoward circumstances of the time, but, as may be expected with but partial success.

The attendance of students attached to technical schools, schools of art, and other schools and classes for further education has fallen considerably. Many of the schools have been engaged in munition work and in the training of munition workers. There was a serious diminution in 1916 in the evening and part-time schools, the number having fallen from 5413 to 3909, as compared with 1915. Much praise is given in the report to the initiative, adaptability, and public spirit of the universities and technical colleges in meeting so successfully the demands set up by the war.

The universities and colleges have continued to make contributions of the highest value to the national cause in the prosecution of abstruse and laborious researches into technical matters bearing upon the war, and especially in the enlightenment and information of public opinion. All this has been done without in the least ceasing to provide for the needs of those able to pursue the ordinary courses of study. The Government has been able materially to aid in this development by financial assistance of a special nature. It is noted in the report with much satisfaction that greatly increased interest has been displayed by almost all sections of the Press and of the public in the possibilities and problems of the universities, than which there can scarcely be a more hopeful sign. "It is being realised," to quote the words of the report, "more clearly day by day how much the welfare and progress of the nation depend upon a highly equipped, accessible, and well-organised system of university education. . . . The war has brought the professor and the manufacturer together, with results which neither is likely to forget." It has apparently taken a devastating war to bring about this consummation. Many important benefactions made to universities and colleges during 1916 in aid of their respective spheres of work are noted in the report.

THE CARNEGIE INSTITUTION AND SCIENTIFIC RESEARCH.

FROM the 1916 Year Book of the Carnegie Institution of Washington we learn that the following grants have been authorised by the Board of Trustees for the current year:—

	£
Administration	10,000
Publication	12,000
Division of Publications	2,100
Departments of Research	126,670
Minor Grants	19,360
Index Medicus	2,400
Insurance Fund	5,000
Reserve Fund	50,000
	£227,530

Among the salient events in the work of the institution during the year under review the following facts referred to in the president's report may be mentioned. The 100-in. reflecting telescope at the Solar Observatory of the institution is nearly completed, and the observatory now possesses an unrivalled equipment for nearly all branches of stellar work, except that of positional astronomy, to which the institution is contributing substantial aid through its Department of Meridian Astrometry.

During the year the non-magnetic ship, *Carnegie*, has added an unexpectedly large mileage to her record. Leaving Lyttelton, New Zealand, on December 6, 1915, she sailed round the world between parallels of 50° and 60° south latitude, a voyage of only 118 days, during which complete observations of the magnetic elements were made on every day except one. Sailing again from Lyttelton on May 17, 1916, she arrived at San Francisco on September 21 following.

The various editions of Ptolemy's "Almagest" have been collated and a new edition was issued by the institution during the year.

"This edition is a result of the joint researches of the late Dr. C. H. F. Peters and Mr. E. B. Knobel. In addition to the profound historical importance of this early work, a great and permanent merit of this latest edition lies in the data it affords for fixation of the relative precision of the ancient determinations of stellar positions. Our admiration for the Alexandrian school of astronomers need not be diminished, however, by the fact that the precision now attained in such determinations is incomparably superior to that attainable by the pioneers in this science twenty centuries ago."

"During the past four years Dr. Frederic E. Clements, professor of botany in the University of Minnesota, has been attached to the department of botanical research as a research associate, and has extended the field studies and elaborated the inductions on which he had been at work previously for many years. The results of his investigations are embodied in a remarkable book entitled 'Plant Succession: An Analysis of the Development of Vegetation.' This work extends the concepts of Darwin and views the successive plant-complexes which invade any region as so many organic units, each enacting its *rôle* no less definitely than is enacted the *rôle* of an individual plant or other organism. This work of Prof. Clements brings the relatively new science of ecology and palæo-ecology prominently forward. It is instructive by reason of the analogies it suggests, especially to the student of contemporary events, between the struggle for existence of the lower species and the struggle for existence of the highest species in the biological world."

The public estimation of the value of research in science as a means of assisting the development of human institutions is referred to in the following paragraphs from the report:—

"Numerous references have been made in preceding reports to the growing realisation of the world at large that the methods of science are the most effective methods thus far developed for the advancement of learning and for the mitigation of the consequences of the inexorable 'laws of Nature' which condition existence on our planet. Reference has been made likewise to the contemporary rise and progress of other research establishments and to the introduction of investigation as an economic adjunct to industrial enterprises. These manifestations of popular approval and confidence continue to be among the most noteworthy signs of the times. Indeed, it is plain that we are now witnessing a remarkably rapid evolution of public understanding of the meaning and the value of research. This has been greatly intensified and accelerated by the European war, the sinister aspects of which appear to be relieved in some degree by the prospects of an awakened realisation of the availability of better methods than those of warfare for settling international disputes, of better methods than those now commonly applied in the government of States, and of better methods in education, in sanitation, in industry, and in biological economy generally. The European war has emphasised to a degree not hitherto attained in the world's history the perils of ignorance, of government by assumed divine right, and of that sort of diplomacy which shades off by insensible degrees into duplicity; and it has emphasised equally clearly the necessity for rational investigation of, and progressive reforms in, all national affairs.

"How the details of this evolution, in which the institution must participate, will work themselves out is impossible to predict except in general terms. It may be safely inferred, however, from the history of similar developments, that this one will proceed much more slowly and with much more difficulty than many enthusiastic optimists anticipate. Evolution is, in general, a secular process, and goes on with a leisurely disregard of individuals. It may be safely inferred also that many of the numerous fallacies which have beset the institution during the brief interval of its existence will recur again and again in the rise of similar organisations, while fallacies of a more troublesome type are likely to beset the introduction of the methods and the results of research in governmental affairs. It is in the latter affairs that the most stubborn opposition to progress is usually met, since there exist, as a rule, in such affairs no adequately developed relations of reciprocity between those best qualified to suggest and to formulate improvements and those who control the machinery for their applications. Such improvements can be secured only by overcoming a stolid adherence to precedent as well as the reluctance of rational conservatism.

"Thus it happens in governmental affairs that the most incongruous ideas often co-exist, as is well shown by the contemporary adoption of the most advanced principles of sanitation in certain European countries which are still dominated by medieval theories of the functions of a State. To cite another illustration readily understood and verifiable, it is an anomalous fact that the United States Government exacts no professional requirements for the direction of its highly technical affairs except in a single branch of its service, namely, the legal. And in line with this glaring national deficiency it is notorious that the fiat of an executive can make an astronomer, a geodesist, or a biologist out of a man whose works are unknown in the annals of the science of which he becomes the *ex-officio* representative.

"We hear much also in these days of the 'mobilisation of genius' in the interests of national preparedness for commercial and industrial competition, if not for the more serious exigencies of national defence; but it is to be feared that this mobilisation means fruitless attempts to utilise aberrant types of mind, or perhaps the employment of men of talent under the direction of those whose competency for leadership is admitted, if at all, only in quite other fields of activity than those here considered. In the meantime, it is plain enough, in the light of current events, that any nation the governors of which mistake necromancy for science, confound invention with investigation, or fail to utilise effectively available and advancing knowledge, is in danger of humiliation in peaceful international competition, if not in danger of extinction in international conflict."

The principles which have guided the research work of the institution and the difficulties with which the

trustees have had to contend are set out towards the end of the president's report in the following words:—

"All experience teaches that effective research depends on painstaking labour, arduously, patiently, and persistently applied; while all science teaches that research is effective only in those regions wherein something like demonstration can be attained. If investigations cannot be well done they are of little worth; if nothing can be proved they are of still less worth, or at best only of negative value. But obvious as these truisms are when stated by themselves, they have been contradicted daily in the plexus of events which make up what our successors will call the history, recorded and unrecorded, of the institution. Thus it has been suggested not infrequently that promising researches be suspended in order that equally or less promising researches might be taken up; and it has happened that proposals to abolish departments of research have been seriously advanced before these departments have had time to prove their rights to existence. It is not infrequently suggested, likewise, by otherwise irreproachable correspondents, that the experts of the laboratories and observatories of the institution be set at work under the direction of amateurs, or, in some cases, of those even who have not reached that earliest stage of capacity in science.

"It goes without saying that all such untoward influences should have little effect on the rise and progress of a research establishment; but he would be an incompetent administrator who failed to recognise the existence and the dangers of these influences. Most men are still opportunists; many contemn principles and theories of procedure; while the characteristic defect of deliberative bodies, strikingly illustrated by legislative assemblies, is lack of deliberation. Moreover, what any organisation, altruistic or otherwise, may accomplish at any epoch, or during any period, will depend very largely on the status of contemporary public opinion. No organisation may be rationally expected to rise much above the level of the ideals of those who support and direct it. The law of averages and the 'law of conservation of ignorance' apply in the business of research no less rigorously than in other affairs of human endeavour. The only difference is that in research, from the nature of the case, we are held to stricter accountability; it is incumbent on us to be alive to the ideals and the theories which lead to regress as well as alive to the ideals and the theories which lead to progress.

"Although popular opinion continues to look upon the institution as an establishment of unlimited means, and hence of unlimited capacities, it is an easily ascertained fact that such advances as have been attained are due chiefly to concentration of effort in a few fields of investigation, the number of these being necessarily limited by the finiteness of income. Of the agencies which have contributed most to these advances the departments of research must be given first rank when quality and quantity of results accomplished are taken in account. These departments have supplied also a much-needed verification of the axiom hitherto admitted in all domains of activity except those of research, namely, that if any good work is required the best way to get it done is to commit it to competent men not otherwise preoccupied. They have verified, likewise, the equally obvious truth that large and difficult undertakings demand foresight and oversight, prolonged effort, and a corresponding continuity of support. The idea that discoveries and advances are of meteoric origin and that they are due chiefly to abnormal minds has been rudely shattered by the remorseless experience of the institution.

"Along with these considerations special mention should be made of another of vital importance to the departments of research. This is their complete autonomy within the limits of their annual appropriations. Allusion is made to this matter here partly for the purpose of correcting public misapprehension concerning the relations of these departments to the institution as a whole, and partly for the purpose of stating formally the theory of administration followed by the institution during the past twelve years. Such a degree of freedom accorded to the departments of research is not only necessary by reason of the extent and the complexity of the affairs of the institution, but it should be regarded as a fundamental principle of sound administration. No one can follow the details of all these varied affairs. A division of labours is indispensable, and to the greatest extent practicable the director of a department of research should be encouraged to be the autocrat of his departmental destiny. But in so far as departments are granted liberty of action it is an equally fundamental principle of administration that they should assume corresponding responsibilities. Autonomous freedom and reciprocal accountability are then, in brief, the essentials of the theory under which the departments of research have evolved."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Prof. Peter Thompson has been appointed Ingleby lecturer for the year 1918.

The council has approved of a recommendation of the Senate that no degree congregation be held this year, and has requested the Vice-Chancellor to sign a special warrant conferring degrees *in absentia*.

The examination pass list just issued contains the name of Prof. J. H. Barnes, principal of the Agricultural College, Lyallpur, and agricultural chemist to the Punjab Department of Agriculture, who has been awarded the degree of D.Sc. for a thesis on "The Insects Attacking Stored Wheat in the Punjab and the Methods of Combating Them, including a Chapter on the Chemistry of Respiration." By a sad coincidence the death of Prof. Barnes, from enteric, has just been announced.

A donation of 1000*l.* to the funds of the University has been received from Mr. F. W. V. Mitchell.

ONE chapter of the new Regulations for Secondary Schools [Cd. 8541] deals with the provision for advanced courses of instruction for pupils between the ages of sixteen and eighteen years of age, and with the financial aid which the Board is prepared to give towards the establishment of such courses. The regulations state that such courses are to be organised in three groups—science and mathematics, classics, and modern studies—and that schools recognised by the Board as fitted by staff, numbers, equipment, and so on, to undertake such work are eligible for grants up to 400*l.* for each course to defray the additional expenditure incurred. The introduction to the regulations indicates that the Board of Education contemplates that in large schools alone will it be possible to arrange advanced courses in each of the three groups, that in the majority of aided schools an advanced course in one subject only will be possible, while in some smaller schools it may not be possible to provide any such advanced teaching. Education authorities are recommended to arrange that each of the three groups shall be provided for in some school in their respective areas, and co-operation between the education authorities of adjoining areas is to be encouraged. Though difficulties in administration are bound to arise in connection with the inaugura-

tion of the new departure, this attempt to prolong the stay of pupils at secondary schools, and to raise the standard of attainment in such schools, will be welcomed by all who appreciate the growing need for a large supply of well-equipped students for our universities in the years immediately following the declaration of peace.

THE question of improving the facilities for the medical education of women was referred to by Sir Gregory Foster, provost of University College, London, at the assembly of the faculties on July 5. He said: "Arrangements have now been completed which will make it possible, when certain structural alterations, to be carried out during the long vacation, have been done, to provide accommodation for women students in the department of anatomy. By taking this step, all the departments of the faculty of medical sciences, like those in the faculties of arts, laws, and science, will be open to women on the same terms as men. The question of providing and extending clinical facilities for women students is still to be dealt with. Its solution is fraught with many difficulties, not the least of which is the absence of many of the senior members of the staffs of the medical schools on the business of war. In the meantime, an arrangement has been arrived at between this college and University College Hospital Medical School under which the teaching of pharmacy is available for women on the same terms as men." The provost also remarked in his address: "It is to be hoped that the Government Reconstruction Committee, which, among other duties, is to undertake the general supervision and review of the changes that may be required in our national system of education, will not overlook the university problem in London. It is, we venture to think, perhaps the most important of the problems relating to higher education, and it should be speedily solved in the interests, not only of this country, but of the Empire as a whole. It is generally admitted that the machinery of government of the University is not what it should be. Machinery of government is not everything, but it is difficult to promote and maintain the true spirit of university life with our present university constitution."

MR. FISHER, President of the Board of Education, distributed the prizes at University College, London, on July 5, and in his speech referred to the great loss of young men of genius and talent caused by the war. Both in France and in this country, he said, the casualty lists have been filled with names which, but for the fatal accidents of war, would certainly have been made illustrious for splendid service to the great cause of life. It is impossible to estimate the extent to which the world will be impoverished in quality by the disappearance of so much youthful genius and talent. Referring to the plans in contemplation for the development of scientific teaching at University College, Mr. Fisher emphasised one feature of university progress which will not, he hopes, be confined to London. It is probable that universities, being faced by enlarged responsibilities involving increased expenditure, will be compelled to resort in increasing measure to assistance from public funds. The Universities of Oxford and Cambridge may preserve that full measure of education which has been not the least among the causes of their influence and progress, but the newer universities, with their meagre endowments, are exposed to the double control of the local authority and the State. Of these two forms of supervision, neither of them free from danger, the latter is greatly to be preferred as likely to be inspired by some comprehensive principle of academic policy. Mr. Fisher thinks that the universities would exercise a greater influence in the life of the country if they could bring themselves to co-operate more closely with one another, and in particular he would like to see a system under which it would be possible for selected students in any one university to spend a term or two of their university residence under some distinguished teacher of their own special subject in another university.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, June 27.—Dr. E. J. Allen in the chair.—Dr. G. H. **Fowler**: A statistical method of analysis of tidal stream observations. By plotting on a diagram of 360° the exact direction of the tidal stream at every hour during a complete lunation, the profound effect of prolonged wind and other extrinsic causes became obvious. Hence in order to obtain a normal (probable) result, abnormal observations must be neglected. This is most safely done by arranging all observations at each hour under their proper directions, plotting them into curves of frequency, and rejecting those observations which are then seen to be due to premature or belated turns of the stream, etc. As the available observations were not numerous enough for other methods, they were grouped under sixteen points of the compass—for example, all observations between N. 12 W. and N. 33 W. were grouped as N.N.W. For each hour after H.W. Dover, the value of each compass-point in degrees of a circle was then multiplied by the number of selected occurrences; the sum of the products divided by the sum of the factors then gave the probable direction of the stream at that hour. Velocities were then simply meaned; and from the data thus obtained ellipses were constructed which showed the direction and velocity of the stream at each hour after H.W. Dover for twelve hours.—C. Tate **Regan**: The distribution of the Clupeinæ. The anadromous habit of the fishes of the shad group leads to localisation and the evolution of genera and species with a restricted distribution; in the strictly marine herrings, sardines, etc., with pelagic larvæ, the majority of the genera and species are more widely distributed.

EDINBURGH.

Royal Society, June 4.—Dr. J. Horne, president, in the chair.—Prof. **Jehu** and Dr. R. **Campbell**: The Highland border rocks in the Aberfoyle district. These rocks were arranged in two divisions: (*a*) the lower series of cherts, shales, and spilitic lavas, with igneous intrusions and bands of highly metamorphosed rocks; (*b*) the upper, or Margie, series of grits, shales, and limestone, with a basement breccia. The upper series is unconformable on the lower. The fossils obtained from the cherty beds include radiolaria, graptolites, hingeless brachiopods, and phyllocarid crustaceans, and fix the horizon of the lower series as Upper Cambrian or the passage beds into the Ordovician. The upper, or Margie, series is placed higher up in the Ordovician, confirmatory evidence being afforded by the remains of crinoids and other organisms found in the bedded limestone. The igneous rocks, both lavaform and intrusive, including their metamorphosed representatives, show affinities indicating derivation from a common magma. The schists of igneous origin have resulted from dynamic metamorphism along a belt of intense shearing, and the altered sediments are due to dynamic superposed on contact metamorphism. The Highland border rocks were shown to be affected by crush lines running with the strike of the rocks. A line or lines of dislocation separated them from the

Leny grits to the north-west.—Mary G. **Haseman**: Knots with a census of amphicheirals with twelve crossings. This discussion followed the lines laid down by Tait in his papers on knots. There were new theoretical developments facilitating the study of knots of higher orders. There were found to be sixty-one amphicheiral knots of twelve crossings. Tait had already given the amphicheirals of lower order, namely, one four-fold, one six-fold, five eight-fold, and thirteen ten-fold.

June 18.—Dr. J. Horne, president, in the chair.—Prof. G. **Kerr**: Note upon an observation on insects and light. This was a description of the manner in which a number of Homopterous insects alighted on the page of an open book in the neighbourhood of an artificial light, each insect rapidly adjusting itself so that its two eyes were equally exposed to the light. As each insect was picked off its position was marked by a short pencil stroke in the direction of its long axis. Had the insects been flying during this orientation they would have flown straight towards the light. This record, which had been made twenty-one years ago in South America, had only recently been recovered. It was a simple illustration of the way in which heliotropism is produced in animals of bilateral symmetry, the tendency being for the eyes to get into positions of equal stimulation, so that the direction of motion is towards the source of light.—Discussion on the simplification of the calendar. In opening this discussion Mr. A. **Philip** suggested modifications which would divide the year into four three-monthly quarters of ninety-one days, and yet would in no way interfere with the position of Easter and the rules by which it was determined. There would thus be complete historical continuity with the Gregorian calendar. The suggestion was to take one day from August and add it to the *following* February. By subsequent exclusion, say, of May 31 from the succession of weekdays, and the addition of another similar day in leap-years, a perpetual calendar would be at once obtained. If, further, the almanac year began on March 1, only one Dominical letter would be required for each year, whether ordinary or leap-year.

DUBLIN.

Royal Irish Academy, June 11.—Sir F. W. Moore, vice-president, in the chair.—Mrs. L. **Porter**: The attachment organs of the common corticolous Ramalinæ. The lichens investigated differ in their mode of attachment to bark from that of others previously described, notably by the German school of lichenologists. The thallus consists of cortex, gonidial layer, and medulla; the cortex is composed of longitudinally arranged hyphæ. Differentiation of inner and outer cortex, and pseudoparenchymatic appearance of the former, depend chiefly upon the reagents used. Attachment organs are strands of hyphæ continuous with the cortical tissue, penetrating the periderm and branching in all directions. From these branches, or from the superficial mycelial layer, or from both, new plants arise. The strands may penetrate the living tissues even so far as the wood.—Miss J. **Stephens**: Report on the sponges collected by the dredging expeditions of the Royal Irish Academy and the Royal Dublin Society off the coast of Ireland. The paper gives a short account of the sponges obtained many years ago by the early dredging expeditions off the west coast of Ireland. The most interesting of these sponges are growing in small, thin encrustations on coral (*Lophohelia prolifera*). Two species are described as new; one of them belongs to the subgenus Paresperella, of the genus Mycale, and is the first representative of this subgenus to be recorded from the Atlantic Ocean.

June 25.—Sir F. W. Moore, vice-president, in the chair.—R. F. **Scharff**, H. J. **Seymour**, and E. T. **Newton**: The exploration of Castlepook Cave, Co. Cork (being the third report from the committee appointed to explore Irish caves). The authors described the results of the exploration of the very extensive chambers and passages of this cave, which is situated within a few miles of Doneraile, Co. Cork. The cave contained vast quantities of reindeer remains, two species of lemming, Arctic fox, as well as adult and young mammoths, bears, wolves, Irish elk, and the cave hyæna. The bird bones seem to have been mostly introduced by fox burrows and pitfalls in recent times. The authors express the opinion that the cave is probably of pre-Glacial origin. After an older set of animal remains had been deposited in pre-Glacial times, the cave remained practically sealed up until comparatively recent times, when another, much more modern, fauna found its way into the cave. It is conclusively shown that the cave hyæna and reindeer were contemporaneous in Ireland, and that the mammoth, Irish elk, and bear flourished at the same time.

Royal Dublin Society, June 26.—Dr. G. H. Pethybridge in the chair.—Miss A. L. **Massy**: The gymnosomatous Pteropoda of the coasts of Ireland. Twelve species are enumerated, taken off the west, south, and east coasts of Ireland. Six species, of which illustrations were given, are described as new, and belong to the genera Pneumodermopsis, Spongeobranchæa, Clionopsis, and Cephalobrachia (one each), and Thliptodon (two). Four species belonging to the genera Pneumodermopsis (two), Cephalobrachia, and Notobranchæa have not previously been recorded from the British and Irish area.—Prof. T. **Johnson**: Pteridosperms from the Upper Devonian beds at Kiltorcan, Co. Kilkenny.—Prof. A. F. **Dixon**: Note on the fragment of the lower jaw from Piltdown, Sussex. Inasmuch as our knowledge of the facial portion of the skull of Piltdown man is derived from a study of the very remarkable fragment found of the lower jaw, it becomes of extreme interest to inquire if its ape-like peculiarities have not been over-emphasised in the various proposed reconstructions of the entire skull. The author believes that it is possible to reconstruct the lower jaw on more distinctly human lines than has been proposed hitherto. From a comparison with the mandible of a Melanesian islander and other specimens from lower existing races, it does not seem necessary to assume that in the Piltdown man there was (1) complete absence of chin (mental eminence); (2) a more parallel arrangement of the pre-molar teeth than in many recent races; (3) enormous development of the incisor teeth; or (4) a square-shaped front to the alveolar part of the jaw. Further, it is not necessary to assume so great a degree of prognathism as is shown in the various reconstructions of the skull that have been published. A reconstruction proposed by the author showed that it was possible that the alveolar part of the Piltdown jaw formed a curve similar to that found in many primitive existing races, and that the mental region may have been as much developed as in them or in the Neanderthal race. No comparison with recent man or ape can detract from the extreme interest of the lower-jaw fragment from Piltdown, but it is very doubtful if the remarkable features which it exhibits are sufficient to support the claim that Piltdown man belonged to a genus different from modern man, or that he may not have represented an early race of *Homo sapiens* from which modern man has been derived.

WASHINGTON, D.C.

National Academy of Sciences, Proceedings No. 5, vol. iii. (May 15).—A. A. **Michelson**: The laws of elastico-viscous flow. A number of empirical formulæ are given.—F. G **Keyes**: A new equation of continuity. A comparison of a modification of van der Waals's equation with experimental results extended over wide ranges, showing satisfactory agreement between the equation and experiment.—E. W. **Berry**: The classification of vascular plants.—C. **Barus**: Displacement interferometry in connection with **U**-tubes.—T. W. **Richards** and N. F. **Hall**: Attempt to separate the isotopic forms of lead by fractional crystallisation One may infer that the molal solubilities of the nitrates are probably essentially identical. and that isotopes are really inseparable by any such process as crystallisation.—G. N. **Collins**: Hybrids of *Zea tunicata* and *Z. ramosa*.—E. P. **Felt**: Distribution of gall midges. A discussion of the existing distribution and of hypotheses concerning the way in which it may have been brought about.—R. **Pearl**: Fertility and age in the domestic fowl. There is a steady and progressive decline in fertility after the first breeding season.—W. A. **Noyes**: A kinetic hypothesis to explain the function of electrons in the chemical combination of atoms.—C. **Barus**: Transverse displacement interferometry.—C. O. **Johns** and D. B. **Jones**: The proteins of the peanut, *Arachis hypogaea.* Peanut meal contains a high percentage of lysine, and could well be used to supplement a diet of corn and wheat.—A. V. **Kidder**: A design-sequence from New Mexico. It has been possible to identify five successive steps in the modification of a design.—J. B. **Ferguson**: The equilibrium between carbon monoxide, carbon dioxide, sulphur dioxide, and free sulphur.—E. B. **Hart**, E. V. **McCollum**, H. **Steenbock**, and G. C. **Humphrey**: Physiological effect on growth and reproduction of rations balanced from restricted sources. Studies pointing to the necessity of the accumulation of further information on the *physiological* behaviour of feeding-stuffs.—J. **Loeb** and J. H. **Northrop**: What determines the duration of life in metazoa? Drosophila has a temperature-coefficient for the duration of life of the order of magnitude of that of the chemical reaction. Since we know that the duration of the larval stage is determined by a specific hormone, we must consider the possibility that the duration of life is also primarily determined by the formation of a hormone in the body.—R. J. **Anderson** and G. **Lusk**: The interrelation between diet and body condition and the energy production during mechanical work in the dog. The accomplishment of a given amount of mechanical work is always at the expense of a given amount of energy, and the amount of energy required for the mechanical work is independent of the physical condition of the subject and of the quantity of carbohydrate present in the gastrointestinal tract.

PETROGRAD.

Academy of Sciences, February 15.—P. P. **Suščinskij**: (1) The geological structure and minerals of Mount Šerlovaja, in Transbaikalia. (2) The geological structure of some new deposits of wolframite in Transbaikalia.—M. M. **Prigovorskij**: Fireproof clays in Central Russia.—V. Č. **Dorogostaiskij**: A short account of the labours of the Baikal Expedition of the Academy of Sciences in 1916.——March 1.—I. M. **Vinogradov**: A new method of obtaining asymptotic expressions.—V. V. **Zalenskij**: The segmentation of the egg of *Sulpa bicaudata* (second period).—V. and E. **Martino**: Materials for the classification and geographical distribution of the mammals of the Kirgise Steppe. Part iii.——March 15.—M. A. **Rykačev**, N. V. **Rose**, R. G. **Abels**, Ja. S. **Bezikovič**, and E. Ju. **Gelin**: The magnetic survey of the Government of Podolsk in 1913.—V. A. **Steklov**: The approximation of functions by means of Čebyšev's polynomials and on quadratures.—N. I. **Andrusov**: (1) The ecology of *Adacna plicata*, Eichw. (2) Post-Tertiary marine deposits of Sinope (Asia Minor).

HISTORICO-PHILOLOGICAL SECTION, February 22.—N. M. **Mogilianskij**: The bicentenary of the Anthropological Section of the Peter the Great Museum of Anthropology and Ethnography.—I. A. **Orbeli**: Armenian rock inscriptions.——March 8.—E. D. **Polivanov**: The accentuation of Japanese bisyllabic adjectives.——March 22.—B. Ja. **Vladimircov** and Prince E. A. **Džavachov**: An anonymous Georgian historian on the Mongolian language.—Th. E. **Uspenskij**: The Trebizond MS. in the Public Library.

BOOKS RECEIVED.

The Fauna of British India, including Ceylon and Burma. *Coleoptera Lamellicornia.* Part ii. By G. J. Arrow. Pp. xiii+387+plates v. (London: Taylor and Francis.) 15*s.*

Can We Set the World in Order? The Need for a Constructive World-Culture. By C. R. Enock. Pp. 198. (London: Grant Richards, Ltd.) 3*s.* 6*d.* net.

Name this Flower: A Simple Way of Finding Out the Names of Common Plants without any Previous Knowledge of Botany. By Prof. G. Bonnier. Pp. xii+331+plates 64. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co.) 6*s.* net.

Organism and Environment as Illustrated by the Physiology of Breathing. By Dr. J. S. Haldane. Pp. xi+138. (New Haven: Yale University Press; London: Oxford University Press.) 5*s.* 6*d.* net.

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THURSDAY, JULY 19, 1917.

ACROMEGALY AND THE EXTINCTION OF SPECIES.

Théorie de la Contre-évolution, ou Dégénérescence par l'Hérédité pathologique. Par le Dr. René Larger. Pp. xiv+405. (Paris: Félix Alcan, 1917.) Price 7 francs.

IN 1885, when Dr. Pierre Marie, who has just succeeded the late Prof. Déjerine in the chair of clinical neurology in the University of Paris, was the youthful director of the laboratory attached to La Salpêtrière, he was impressed by the similarity of the condition and symptoms presented by two women who had entered the great nerve hospital as patients. In both women a disastrous change had been wrought in their physical appearance and well-being; in the course of a year or two their faces had become big and ugly, so that even their relatives and friends failed to recognise them; their hands and feet grew in size and changed in shape, although the normal period for growth was long past. Dr. Marie perceived that the morbid state presented by these two women was identical, and that it was a diseased condition which, up to that time, had passed unrecognised. He published an account of his two patients,[1] giving the name "acromegaly" to the condition, because of the enlargement of the extreme parts of the body—the hands, feet, and face.

The original description was no sooner published than cases began to be reported by clinicians from every part of the world. Hundreds of cases are now on record. Very soon it was recognised that nearly all giants, besides suffering from a generalised overgrowth, were also the subjects of this peculiar, or acromegalic, kind of growth. As a result of thirty-two years of observation and experiment it may be regarded as now certain that gigantism, acromegaly, and a number of other conditions are directly related to a disordered state of the pituitary gland—an organ so minute that it forms only $\frac{1}{150000}$ part of an adult human body.

In his theory of "contre-évolution" Dr. René Larger has developed the idea that gigantism and acromegaly may attack not an individual here and there as amongst mankind, but may break out in a whole species or genus, so that all the individuals become affected, at first with a moderate degree of acromegaly, but finally with an unrestrained pitch of gigantism, in which condition the whole race or family finally perishes. He is of opinion that his theory explains many facts which now seem obscure to those who are studying living and extinct forms of animal life. He selects his examples from the great dinosaurians, the living and extinct great birds, and whales, elephants, and anthropoids, as mammalian representatives.

Although we are willing to admit that Dr. Larger is the first to apply in a systematic manner certain medical concepts to problems concerning the evolution and extinction of animal forms, and that he has rendered a service to biologists in doing so, we do not think that either his confrères in France or his colleagues abroad will agree that he has done justice to the present state of our knowledge regarding the growth of the human body. Dr. Larger regards the enlarged or disordered state of the pituitary gland, which is invariably found in the subjects of gigantism and of acromegaly, as merely one of many manifestations of the disease, whereas the prevailing and best-founded opinion is that a direct and causal connection exists between the disorder of the pituitary gland and the disturbance of growth. The pituitary is, however, only one element in a series of growth-controlling glands. In the mechanism of growth and of adaptation of the body to its surroundings the genital glands, the adrenal gland, the thyroid, the pancreatic, and the pituitary glands, and many minor bodies, take a part; between them they determine the shape given to the body, and the form given apparently depends on the dominance of one or more of the members of this growth-controlling endocrine mechanism.

When in his Croonian lectures of 1905 Prof. Starling gave the name of "hormones" to the "chemical messengers" sent out by one organ of the body to control the action or growth of any other organ or part of the body, he and Prof. Bayliss had a very clear appreciation of the important part hormones were to play in all biological investigation and speculation. They realised that they were dealing with the most primitive mechanism for co-ordinating the functions and systems of a composite animal body—one which must have ante-dated the appearance of a nerve-system, and could serve to link the tissues of the body to the germ plasm of the unborn seed. We cannot say that zoologists have shown any undue haste in applying and testing the theory of hormones.

In 1908 Mr. J. T. Cunningham (Proc. Zool. Soc., p. 434) applied the theory of hormones to explain inheritance; in his presidential address to the Section of Zoology of the British Association at Sheffield in 1910 Prof. C. C. Bourne clearly recognised the *rôle* of hormones in the evolution of new forms; in recent writings by Prof. A. Dendy and by Prof. E. W. MacBride it can be seen that they, too, have grasped the importance of hormones to zoologists. It is this wider concept of hormones that we should prefer to see applied to the problems which Dr. Larger has dealt with in his theory of "contre-évolution," but, even if we cannot get the whole loaf, we must be thankful to him for a piece of real bread.

A. KEITH.

[1] *Revue de Médecine* (1886), vol. vi., p. 297.

ELECTROTECHNICAL BOOKS.

(1) *The Range of Electric Searchlight Projectors.* By Jean Rey. Translated by J. H. Johnson. Pp. xiv+152. (London: Constable and Co., Ltd., 1917.) Price 12*s.* 6*d.* net.

(2) *The Calculation and Measurement of Inductance and Capacity.* By W. H. Nottage. Pp. 137. (London: The Wireless Press, Ltd.) Price 2*s.* 6*d.*

(3) *Electric and Magnetic Measurements.* By

Charles Marquis Smith. Pp. xii+373. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 10*s.* 6*d.* net.

(4) *A Laboratory Course of Practical Electricity for Vocational Schools and Shop Classes.* By M. J. Archbold. Pp. ix+211+exp. 98. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5*s.* net.

(5) *Electrical Measurements and Testing: Direct- and Alternating-Current.* By Chester L. Dawes. Unpaged. (New York: John Wiley and Sons, Inc.) Price 3*s.* net.

(6) *Electrical Laboratory Course for Junior Students.* By Prof. Magnus Maclean. Pp. 120. (London: Blackie and Son, Ltd., 1916.) Price 2*s.* net.

(1) SINCE the outbreak of the war there has been an urgent demand by our air, naval, and military forces for information relating to the range of searchlight projectors. We therefore welcome this translation of M. Jean Rey's work. It is an open secret that during the course of the war very great improvements have been made in the manufacture of the carbons for projector lamps, and that they give a flux of light for a given power consumption from three to five times as great as that obtained from the old carbons.

The first electric searchlight was made by Louis Sautter in 1867. In the early lamps the carbons were arranged so that their axes were inclined at an angle. The efficiency was high, but the regulation of the carbons was a difficult and delicate operation. They are now always arranged with the carbons horizontal. In the first chapter the author gives an account of the experiments he carried out in the laboratory of the Sautter-Harlé works in 1902. He proved that for small arcs taking from 10 to 50 amperes the efficiency—that is, the ratio of the luminous flux to the electric power—increases with the current, but above 50 amperes the efficiency diminishes as the current increases. For instance, with a current of 250 amperes the efficiency is 13 per cent. less than with a current of 50 amperes. He also proved experimentally that the diameter of the crater was proportional to the square root of the product of the diameter of the positive carbon and the current. In chap. ii. formulæ are given for the illumination obtained with a specified reflector. From these it appears that, neglecting absorption, the illumination at a given distance is proportional to the square of the focal length of the reflector, and is inversely proportional to the square of the diameter of the crater. The efficiency of electric searchlights is next considered, the losses due to the front glass, the shadow losses due to the lamp, and the losses due to the flashing shutters being taken into account.

Blondel's law for the range of a searchlight is fully explained, and values are given for the coefficient of atmospheric transparency. When the humidity of the air is great the coefficient is perceptibly reduced, and when the air contains particles of dust the coefficient is very appreciably diminished. In the last chapter the difficult problem of the influence of visual acuity on the range is discussed, and references are given to Blondel's work.

Numerous interesting phenomena are mentioned. For example, when convoys, pioneers making trenches, aviators, etc., are caught by the beam of a searchlight at a great distance they generally imagine that they must be visible to the enemy and so take cover. It is pointed out that in many cases the enemy would be quite unable to see them. The work will prove of great value to engineer officers. We have noticed one or two misprints in some of the mathematical equations, but the corrections are obvious.

(2) A knowledge of easy methods of measuring and of rapid methods of calculating with high accuracy the inductance of currents and the capacity of conductors is of great value in radiotelegraphy. On these subjects, therefore, a great deal of experimental ingenuity and mathematical labour have recently been expended. Mr. Nottage begins by giving formulæ for inductance and capacity, and he illustrates their use by numerous numerical examples. He then describes experimental methods of measuring these quantities, and finally gives brief descriptions of the appliances now used in making these measurements. Extensive use has been made of papers which have recently been read to the London Physical Society and to the Institution of Electrical Engineers.

As the author is writing for the benefit of physicists and engineers, the mathematical proofs of the formulæ, which are as a rule long and tedious, have been omitted. The publication of a formula without proof, however, has its drawbacks. The user of a formula obtained in this way is at the mercy of misprints. As the limitations of the formulæ also are not given in all cases, he may easily fall into error. In chap. ii., formula (11), p. 41, we notice that in the formula for the joint capacity of two spheres ·3863 has been printed instead of 1·3863. The limitations of the formula for the inductance of a rectangle are not stated. Rayleigh's formula for the inductance of a concentric main, which is perhaps the most important of them all, has been left out altogether.

On p. 47 a formula (18) is given for the average potential of a single straight wire. We are quite unable to make sense of the formula. It is stated to be only approximate, but then the "accurate expression" (19) is also given; and finally, we are told that for all practical purposes the difference between the two formulæ is negligible. Doubtless also to the same degree of accuracy the approximate formula for the capacity of a wire deduced from that of a prolate spheroid by making the equatorial axis very long will agree with either. Unfortunately, the exact solution is not known. We therefore have to pass over the next fourteen pages, as we cannot understand them. Heaviside has shown how to calculate the capacity and inductance of horizontal antennæ

("Electrical Papers," vol. i., p. 42 and p. 101, or Russell, "Alternating Currents," vol. i., p. 199).

The collection of methods of measuring inductance and capacity given in chaps. iii. and iv. will be found useful. The discussion in chap. vi. of Duddell, Campbell, and Drysdale vibration galvanometers is good so far as it goes, but the reader would be grateful for more information. The author seems to have written the book rather hurriedly. The wireless electrician and the physicist, however, will find it useful.

(3) Prof. Smith's book consists partly of lectures and partly of laboratory exercises on electric and magnetic measurements. The arrangement of the subject is good, and the lengthy definitions and explanations of units will be helpful to students. The definitions of self and mutual inductance are very properly given in terms of the linkages of flux and current, but the author has not made it quite clear what a linkage is. In order to explain what is meant by a linkage, it is necessary to show how the linkages of the magnetic flux inside the wire itself with fractional parts of the current can be calculated. As an elementary knowledge of the calculus is presupposed, this can easily be done.

The definitions of electrostatic capacity are not quite happy. No clear distinction is made between the capacity of a conductor and the capacity between two conductors. For example, the author says that a condenser is "a device by means of which the capacity of an isolated conductor can be very greatly increased" by the presence near it of another charged conductor. Unless, however, the conductors have equal and opposite charges, the equations given later do not apply. The book is clearly printed and the methods are up to date.

(4) These leaflets form a laboratory course for boys and apprentices in vocational schools and shop classes. Gaps are left in the printing of the leaflet where the boy has to write down what he has observed, and spaces are provided for a sketch of the apparatus used and for a graph of his results. Rough sketches are given in the appendix of the apparatus used, and these will be a great help to beginners. Numerous easy examples are given. The leaflets are excellently adapted for the class of student for whom they have been written. The Brown and Sharp Wire Table and the "circular mil" are much in evidence. The "circular mil" is a quaint unit, being the area of a circle 1 mil (0·001 of an inch) in diameter. We hope that it will soon become obsolete.

(5) Mr. Chester Dawes is instructor in electrical engineering at Harvard University. This "loose-leaf" laboratory manual is intended to be used in conjunction with Timbie's "Electrical Measurements" and Karapetoff's "Elementary Electrical Testing." The leaflets are thoroughly practical, and the arrangement of the experiments is excellent. After doing, for instance, the experiment on "conduit-wiring," the student would have acquired excellent ideas about the best methods of installing electric-light wires in conduits. He would also know how to make joints in cables and how to test their insulation resistance. Given an elaborate electrical laboratory, this manual is admirably adapted to train students to become really useful electricians in the minimum possible time. Some of the questions asked on the leaflets will give them plenty of food for thought.

(6) This book gives a well-arranged series of experiments suitable for a junior course in an electrical engineering laboratory. They are all thoroughly utilitarian and will be a great help to the student when he goes to an electrical works or a power station. Prof. Maclean asks the student to obtain the "efficiency" of an arc lamp in watts per mean hemispherical candle-power. He very properly puts the word "efficiency" between quotation marks. The efficiency is really the mean hemispherical candle-power per watt, and it is high time that this definition were adopted by engineers. We are doubtful whether the use of Rousseau's diagram to measure the mean hemispherical candle-power of arc lamps is justified, considering how uncertain some of the measurements are owing to the continual fluctuation in the intensity and the colour of the light. One of the simpler methods of approximating to the mean hemispherical candle-power would be more suitable.

A. RUSSELL.

OUR BOOKSHELF.

Lessons in Pharmaceutical Latin and Prescription Writing and Interpretation. By Hugh C. Muldoon. Pp. vii.+173. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6*s*. net.

FOR the past quarter of a century the Latin used by medical practitioners in writing their prescriptions has become more and more simple, and the use of the vernacular has correspondingly increased. Nevertheless, so many prescriptions are still written in that language that the pharmacist must be sufficiently well acquainted with it to interpret them correctly. The author assumes no knowledge of Latin on the part of the student and endeavours to teach him what is essential in the limited time at his disposal. To accomplish this, much of the conjugation of the verbs and of the declension of the nouns, and so on, has been omitted, and the student's attention concentrated on those parts which are of constant recurrence.

The work is divided into twenty-five chapters. From the commencement the exercises are based on such words and expressions as occur in prescriptions, passing from the simplest to the more complex. While it is not, and does not profess to be, a complete Latin grammar of pharmacy, it certainly embodies a rational method of teaching a student the Latin essential to his calling without burdening his memory with a host of conjugations and tenses with which he will never meet. The necessary rules are clearly and concisely stated. Though written for American students, it can equally well be used by British, and undoubtedly deserves to meet with success.

British Insects and How to Know Them. By Harold Bastin. Pp. ix+129. (London: Methuen and Co., Ltd., 1917.) Price 1s. 6d. net.

THE inquiry often made by beginners for a small book giving trustworthy, if elementary, information about the common insects of our countryside may be safely answered by a recommendation of this handy little volume. After a short introductory chapter on the general characters of the Insecta and some of the varieties in life-history to be observed among them, the author takes a survey of the orders in ascending series, describing the leading structural features, the transformations, and the habits of the principal families as illustrated by their commoner and more conspicuous genera and species. The book contains a relatively large amount of information on systematic entomology, but Mr. Bastin has so much of interest to tell about the mode of life of many of the creatures which he mentions that the effect is far from that of the dry, catalogue-like summary which might easily have been the result of an attempt to survey the whole class of insects in little more than a hundred pages. The book is illustrated with twelve photographic plates, on each of which five or six figures are printed with admirable definition and softness. The frenulum and retinaculum of a hawk-moth's wings on plate ix. may be mentioned as treated with special success.

G. H. C.

Fresh-water Wonders and How to Identify Them. By J. H. Crabtree. Pp. 64. (London: C. H. Kelly.) Price 1s. 3d. net.

THE author of this little volume is an enthusiast on pond-life, and he seeks to introduce others to what has been to himself a world of wonder and beauty. He deals with diatoms, desmids, confervæ, Volvox, water-weeds of many kinds, amœbæ, infusorians, Hydra, rotifers, Bryozoa, Annelids and some other worms, bivalves, water-snails, water-fleas, crayfish, insect-larvæ, and amphibians. There are thirty photographic illustrations, many of which will be useful to beginners in identification.

It is a simple, unambitious book, but the author's standard of accuracy should have been higher. The amœba does not "flit about"; the young "volvoces" do not occupy "the parent cell"; the bell-animalcule does not feed on smaller "hydrozoa"; nematodes are not Annelids, nor "segmented like the river-worm"; a Cercaria is neither an Annelid nor a Planarian, as is alleged; the fresh-water mussel does not feed ravenously on water-spiders; the antennæ of Daphnia are not fringed with cilia, nor are the swimmerets of the crayfish. Whatever one may say at the fish-monger's, it seems a pity in a book to call the crayfish a fish, especially after calling it a crustacean. And why should one compare a tadpole with a "fish without wings"? We are amazed at the easy-going way in which the author has tolerated numerous inaccuracies. It is not the way of science.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radiation-Pressure, Astrophysical Retardation, and Relativity.

THE conclusion was reached by the late Prof. Poynting (Phil. Trans., 1903) that the radiation from a material body in space gives rise to a small retarding force, which acts cumulatively as a brake on its movement through the æther; and the consequence was deduced, the significance of which has not yet been exhausted, that the sun's radiation, acting in concert with its gravitation, operates to keep the solar system swept clear of fine cosmical dust. The system may travel through nebulous clouds, but no such clouds can permanently belong to it.

A view seems to be prevalent that this conclusion contradicts electromagnetic theory, because for an isolated radiator like a star this force of retardation is specified as proportional to its velocity through the æther, and this is said to violate the principle of relativity (see, for example, the *Observatory*, July, 1917, p. 275, on "Radiation-Pressure and the Solar Rotation"). The evolution of mathematical theories is now carrying the modes of formulation of that principle far away from the simple considerations on which it originally reposed; but it can fairly be said that none of the original enunciations seek to apply the principle that all motions are relative to systems that are not self-contained. If a body is losing its energy by radiation, it must surely stand in relation to the bodies or to the medium to which it transfers that energy, even though it be a star remote from all other bodies. Any kind of relativity that supersedes this consideration would seem to stand in self-contradiction.

As a matter of fact, however, Prof. Poynting's principle has nothing to do with the refined second-order negative results which were the source of the very interesting modern development regarding relativity. His effect is proportional to the first power of the velocity of the system; it is thus a direct consequence of the original Maxwellian theory, now universally accepted; to traverse it would appear to knock over the whole fabric of modern mathematical physics. How to reconcile it with special views on relativity is another matter.

The argument on this point may be found set forth in Proc. International Mathematical Congress, Cambridge, 1912 (vol. i., p. 213, "On the Dynamics of Radiation"), or in the forthcoming collected edition of Prof. Poynting's papers. It appears from it that the effect of the solar radiation incident on a particle of dust, in orbital motion round the sun, is simply to reduce the factor of its gravitation, while the effect of its own radiation again of the radiant energy which has been absorbed by it from the sun is to retard in a frictional manner its motion through the æther. There can be no question in general of this retardation being exactly annulled or compensated by diminution of the inertia of the particle due to loss of its energy; in the present case the particle, in fact, absorbs just as much energy as it radiates. The principle and its cosmical results seem to stand firm on established laws, and *a priori* views as to relativity must adapt themselves to it. Any attempt in that direction will have to take account of the inertia of free travelling radiation.

JOSEPH LARMOR.

Cambridge, July 14.

Oceanic Tidal Friction.

In equation (26) of a paper in the current number of the Proceedings of the Royal Society (93 A, pp. 348–59) Mr. R. O. Street has given an expression for the rate of dissipation of energy in the oceanic tides which is probably the best yet obtained; it is proportional to the square root of the viscosity and to the square of the surface velocity. In view, however, of the uncertainty of many of the data involved, which he carefully states, some further discussion of the subsequent numerical application seems desirable. At the end of the paper it is shown that a periodic surface velocity with a maximum of 2 ft. per second all over the ocean, with a viscosity of $1 \cdot 4 \times 10^{-5}$ ft.^{2}/sec., would account for a retardation of the earth's rotation of amount 4′ of arc per century per century. Now it is easy to find from equations (11) on p. 303 of Lamb's "Hydrodynamics" that the surface velocity in mid-ocean for a tide of height 2 ft. is only of order 0·04 ft. per second; on the other hand, the effective viscosity is very much increased on account of turbulence. The available data on this question are scanty, but the writer has shown elsewhere (*Monthly Notices of R.A.S.*, vol. lxxvi., 1916, p. 512) that the effective viscosity in the ocean is probably of order 4 cm.^{2}/sec.= $4 \cdot 4 \times 10^{-3}$ ft.^{2}/sec Thus Street's retardation must be multiplied by $(0 \cdot 02)^2(300)^{\frac{1}{2}}$, giving 0·02′ per century per century, which is inappreciable. No great part of the observed lunar acceleration can therefore be attributed to tidal friction in mid-ocean. The dissipation in shallow regions near the coast may be greater, as the velocity is greater there, but in view of the limited area concerned the total is unlikely to be important. As the retardation of the earth's rotation that is required to account for the lunar acceleration is about 10′·4 per century per century (*ibid.*, vol. lxxvii.; 1917, p. 453), Street's result on the whole confirms those of the earlier investigators, who regarded oceanic tidal friction as very small in amount, and were disposed to refer all the dissipation, if any, to the bodily tides.

Harold Jeffreys.

St. John's College, Cambridge.

Gravitation and Thermodynamics.

Attention has been given in Nature to various deductions from the results of Dr. P. E. Shaw's experiments on "The Newtonian Constant of Gravitation as affected by Temperature" (Phil. Trans., A, 544, 1916). So far as the present writer is aware, attention has not been directed to the suggestive remarks of the late Prof. G. F. Fitzgerald, to be found in his Helmholtz memorial lecture (Transactions Chemical Society, 1896, pp. 889–95). In the course of his reference to Helmholtz's contribution to the theory of vortex motion, Fitzgerald remarks:—"It is difficult to weigh hot bodies accurately, and, in consequence, there does not seem to be any conclusive proof that the weight of a body does not change with its temperature. If it does not do so by a measurable amount, the simple vortex ring theory of matter can hardly be true."

J. S. G. Thomas.

709 Old Kent Road, S.E.15, July 4.

The First New Moon in the Year 1 B.C.

In making some computations last March about the occurrence of new moon, an error of statement was discovered in the ninth edition of the "Encyclopædia Britannica" under "Calendar," vol. iv., p. 594, and repeated in the eleventh edition, vol. iv., p. 993; it is also given in Barlow and Bryan's "Mathematical Astronomy," p. 215. The erroneous statement is that new moon occurred on January 1 in 1 B.C. New moon in January, 1 B.C., occurred on January 25, 12h. 26m. Jerusalem Mean Civil Time.

Dominion Observatory, Ottawa. Otto Klotz.

PHOTOGRAPHS OF AURORA.

Attempts to measure the height of aurora were made prior to the end of the eighteenth century, and have been repeated at intervals since that date. The most direct method is obviously to determine the parallax as given by synchronous observations at two stations a sufficient distance apart. In the case of the earlier attempts to apply this method, it was only by the merest accident that observations would have been taken simultaneously, and even in that event it was improbable that the same point would have been selected for observation. Thus it was impossible to feel any great confidence in the older results, though, as a matter of fact, some of them were probably not far wrong. After the invention of the telephone, it became possible for two observers a sufficient distance apart to make simultaneous observations with theodolites, but some uncertainty necessarily prevailed as to the identity of the points selected for observation. Observations made in this way at Godthaab, in Greenland, with a 5·8-kilometre base, discussed by Prof. Paulsen thirty years ago, gave for the lower edge of aurora heights varying from 0·6 to 67·8 km., the average being only some 20 km. At Godthaab, however, the parallax was too small to measure in some 20 per cent. of the cases.

Towards the end of last century several people succeeded occasionally in attempts to photograph aurora, and in 1909 Prof. Carl Störmer, of Christiania, devised a satisfactorily successful method of securing photographs with only a few seconds' exposure, and in 1910 he and his assistants secured a good many pairs of photographs from two stations 5 km. apart, near Bossekop, in the north of Norway.

In 1913 Prof. Störmer took a much larger number of photographs, employing a longer base, observations being made at Bossekop and Store Korsnes, 27½ km. apart. His photographs include known stars as well as the aurora. An auxiliary photograph of the face of a watch gives the exact time, and thus the position of the star. A series of corresponding points can usually be recognised in the two photographs, and the geographical position as well as the height of the aurora—whether an arc, a band, a curtain, or a ray—can be calculated. The accompanying figures are reproductions of two pairs of photographs obtained by Prof. Störmer and his assistant in 1913.

Prof. Störmer has recently discussed in *Terrestrial Magnetism* a number of the measurements made on the photographs which he took in 1913. The majority of his calculated heights refer to the lower edge of the aurora, partly, no doubt, because it is usually the best defined, and partly because it possesses especial interest in connection with the theory which he supports, viz. that aurora arises from electrical corpuscles discharged from the sun. On this theory, the lower the visible limit of aurora, the more penetrating the discharge. Out of about 2500 height

measurements, based on the photographs taken in 1913, only twenty-one gave an altitude under 90 km., and only sixteen an altitude above 220 km., the highest being 323 km. Nearly 70 per cent. of the heights ranged between 96 and 120 km. Prof. Störmer claims that, as regards frequency of occurrence, the results show two distinct maxima, one between 101 and 103 km., the other between 105 and 108 km.

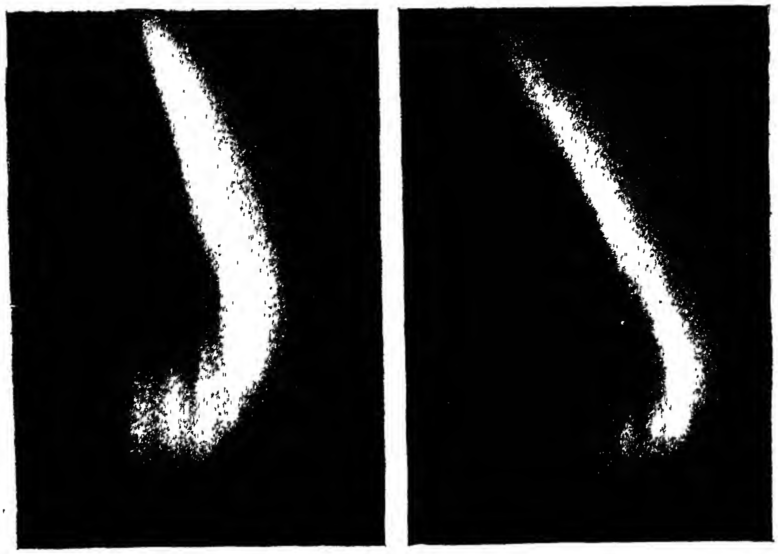


FIG. 1.—Aurora borealis, photographed simultaneously from Bossekop (right) and Store Korsnes (left) on March 11, 1913, 11h. 36m. G.M.T. Altitude of the lowest parts 93–99 km. The star is Deneb.

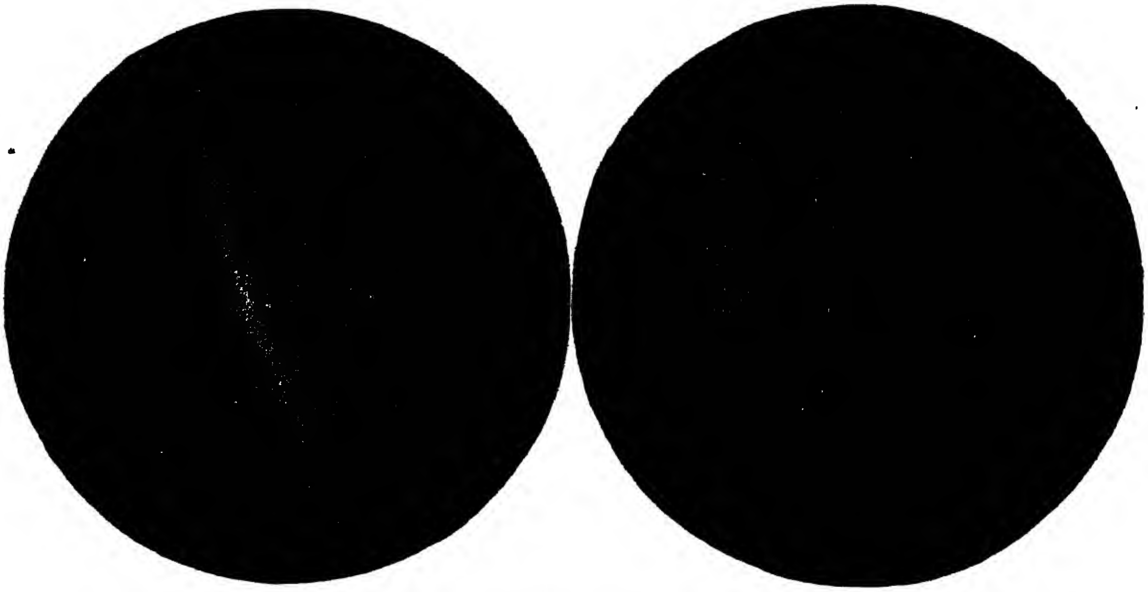


FIG. 2.—Aurora borealis, photographed simultaneously from Bossekop (right) and Store Korsnes (left) on March 30, 1913, 9h. 20m. G.M.T. Altitude of left border about 120 km. The stars of Lyra in the background.

The year 1913 was one of sunspot minimum, and Prof. Störmer seems disposed to associate sunspot minimum with low penetrating power in auroral rays, and so great height in the lower edge of aurora. This seems necessary to explain the fact that in 1910 he observed heights under 50 km. on several occasions. Moreover, unless this proves to be the case, or auroras attain much lower levels in Greenland than in Norway, we must suppose Prof. Paulsen's estimates to have been seriously at fault. The frequent association of aurora with magnetic disturbance gives an additional interest to Prof. Störmer's work. It is of obvious importance to have exact information as to the changes in progress in aurora during the large movements frequently shown on magnetograms during magnetic storms.

C. CHREE.

THE DYE PROBLEM AMONG THE ENTENTE POWERS.

THE synthetic dye problem as it presents itself to the French chemist was admirably stated by Prof. Auger in an address delivered on February 11 to the Société des Amis de l'Université de Paris. For more than forty centuries the art of the dyer was restricted by the narrow choice of available colouring matters. The ancients were acquainted with only ten dyeing principles, namely, Tyrian purple, madder, archil, weld, Persian berries, anatto, woad, indigo, catechu, and the tannins, the last two applied either alone or with iron mordants. This short list represents a very restricted range of colours, dyeing in various shades of red, yellow, orange, blue, brown, and black. Green dyes were unknown to the dyers

of antiquity, who were forced to utilise mixtures of blue and yellow. The choice of medieval dyers was even narrower, for Tyrian purple became obsolete with the lapse of time, owing to the cost of production. But with the great geographical discoveries of the sixteenth century four new natural colouring matters were added to the list, namely, cochineal, logwood, quercitron, and fustic, and the use of indigo, which had fallen into abeyance, was revived.

The birth and development of modern chemistry added in the period 1790 to 1853 six more dyes and pigments: picric acid, chrome yellow, chrome green, Prussian blue, artificial ultramarine, and murexide. The period of intensive colour production began with Perkin's synthesis of mauve, since when many thousand dyes have been produced, of which about 3000 have at one time or another been utilised by dyers. The capture of this industry by German industrialists placed at the disposal of their military chiefs a new form of offensive, namely, war with poisons. The asphyxiating gases, chlorine and phosgene, and the lachrymatory liquid, benzyl bromide, were prepared in large quantities for the colour industry, and were ready to hand for a more nefarious use.

The tragic story of the red trousers adopted for the French Army constitutes one of the world-war's most cruel ironies. This colour was originally selected in order to encourage the cultivation of French madder, which colour principle was, however, entirely superseded by artificial alizarin in 1876. Nevertheless, the French War Office disbursed annually vast sums in the purchase of the latter dye from the Badische Anilin- & Soda-Fabrik, an astute German firm, which very obligingly established a special shade of alizarin red to suit the requirements of their French clients. With the outbreak of war the lives of thousands of France's incomparable soldiery were sacrificed to demonstrate that this excellent red, worn to support a dead industry, was an admirable target for the enemy.

This sombre episode is typical of the methods of peaceful penetration by means of which German industrialists endeavoured, only too successfully, for forty years before the war to acquire that chemical predominance which was to pave the way for military victory over their short-sighted rivals. The secret of this German success was to concentrate on essentials. Germany was alone at first in recognising what should be the correct relationship between theory and application, and between science and industry. Its Government assigned no limits to the endowment of universities and to the enrolment and encouragement of professors. The latter gained glory and profit from any of their discoveries receiving technical applications. German manufacturers prided themselves on possessing research laboratories rivalling, and often excelling, those of the universities. Sure of ultimate success, they no longer imposed on their research chemists the crippling task of obtaining immediately profitable results. Conscious that the field of inquiry is illimitable, they did not demand of their pioneers and prospectors payable discoveries to order. As the result of this far-sighted policy, carried into practice by patient and systematically co-ordinated workers, German industrialists ultimately were enabled to make discoveries which rendered them masters not only of the colour industry, but also of all other industries depending on chemical synthesis, such as the manufacture of pharmaceutical and photographic products and the production of artificial perfumes. In this way the large German firms acquired a systematically recorded mass of detailed practical experience which is far more valuable to them than their financial resources. It is true that the principles underlying the production of dyes and other fine chemicals may be gleaned from a perusal of patent specifications and other scientific publications; yet these disclosures are more apparent than real, for it is certain that very few, if any, of these processes, if carried out as described, could meet the competition which existed before the war. Large staffs of experienced technical chemists are required to put these syntheses into effective operation.

In the meantime, non-German chemical manufacturers and chemical users had fallen to a position of subordinance. The part played by the former was the collection of German intermediate products and the conversion of these substances into dyes, a comparatively simple and inexpert task compared with the highly skilled processes by which these intermediates were manufactured. The German manufacturers were very liberal towards their subordinates, and even encouraged the development of foreign factories of this type, realising that in these dependent enterprises they had very useful allies, which, by obscuring the ultimate origin of the dyes and other chemical products, neutralised national prejudice and flattered local patriotism by a spurious show of manufacturing activity.

One of these subservient French factories was at the outbreak of war devoted to the production of synthetic indigo from intermediates sent from Germany. This factory has since been requisitioned by the French Government, and with the aid of a committee formed to deal with chemical and pharmaceutical products is now organised to manufacture synthetic indigo for the new military uniforms.

It is satisfactory to note that a similar success has attended British efforts to cope with this important colour. The Rhenish firm of Meister, Lucius, & Brüning had installed at Ellesmere Port a factory in which only the last stage of their indigo synthesis was practised, in order that the firm might comply with the requirements of the English Patent Laws. Last year this factory was acquired by the Manchester firm of Messrs. Levinstein, Ltd., which at present is carrying out the indigo synthesis in all its stages on a larger scale than was the case when the works were still in German hands.

The steps taken in France to cope with the dye famine and other problems of chemical synthesis arising from the war are singularly comparable with those made in England. In both countries

the Government has intervened to form State-aided companies, and British Dyes, Ltd., has its French analogue in the "Société Nationale des Matières Colorantes et Produits Chimiques." Meanwhile, private enterprise has played a very important part. The last surviving independent French dye factory at Saint-Denis has greatly increased its capital and organised its resources in order to deal intensively with dye production as soon as the claims of the explosives departments have abated. In Lancashire, Messrs. Levinstein, who have achieved noteworthy success as dye-makers, now form the nucleus of a group of co-ordinated firms working amicably in the production of dyes and other synthetic products. These firms, which include the Ellesmere Port indigo factory and Messrs. Claus, of Clayton, near Manchester, have working arrangements with other industrial undertakings not only in Great Britain, but also so far afield as Italy and America. This combination of the Lancashire colour firms and their associates is at present a most hopeful sign of renaissance for the chemical industries of the Entente Powers.

G. T. MORGAN.

FRANCE AND NATIONAL SCIENTIFIC RESEARCH APPLIED TO INDUSTRY.

THE French Société d'Encouragement pour l'Industrie Nationale, always to the fore in matters of vital moment to industry, has recently been dealing with the question of scientific investigation as applied to manufacture. The "Economic Arts" Sub-Committee in particular is greatly interested in the co-ordination and co-operation of the various research and test laboratories in the country with the view of bringing science and industry into more direct contact after the war. In No. 1 (1917) of the society's Bulletin General Sebert has an article on the various establishments of the kind. Many of the Government departments in France have their own special laboratories, *e.g.* the various research laboratories of the French War Office and the Munitions Inventions Committee. A number of the scientific societies also have their own establishments, *e.g.* that founded by the Society of Electrical Engineers in 1886. Many tests are made there for different Government departments, and a number of important researches in electricity have been undertaken. Then there is the laboratory created by the French Photographic Society, which has done good work for the photographic profession and trade, and, more recently, for the kinematograph trade. By a decree passed in 1900 it was decided to widen the scope of the mechanical laboratory founded in 1854 by General Morin, the result being the foundation of the Laboratoire d'essais at the Conservatoire national des arts et métiers. To this institution many technical societies have made grants. It is divided into five sections, viz. physics, metals, materials of construction, mechanics, and chemistry. Here certain primary and secondary standards are kept. This laboratory has done good work in the carrying out of routine testing of all kinds, but its operations are evidently circumscribed through lack of funds. The laboratory had to close at the beginning of the war, though it has since been reopened at the instance of the Munitions Inventions Committee for the carrying out of experiments relating to war problems.

Useful as such establishments are, however, there is a strongly felt desire to establish in France a National Laboratory on the scale of our own National Physical Laboratory, the Bureau of Standards (U.S.A.), and the Reichsanstalt at Charlottenburg.

M. Armand Gautier, of the Institute, recently expressed at the Academy of Sciences his personal ideas regarding the creation of a central laboratory of the kind, and an epitome of his contribution is printed in the Bulletin of the Société d'Encouragement already referred to. He suggests the formation of a council consisting of manufacturers of the first rank, scholars who are specialists in particular branches of science, and a small number of Ministers of State or members of the National Council. This council would draw up a list of the questions to be dealt with and appoint the most eminent men to carry out the investigations. The council would also approach the manufacturers, etc., who would be most likely to benefit from the researches, and the latter would do the rest by the provision of annual grants for the execution of the work. The State would have no responsibility, direction, or supervisory powers, but would provide the funds necessary for the establishment and equipment of the institution. Each manufacturer would undertake to assist according to the extent of his business, but the share of each would be fixed as low as possible. M. Gautier thinks that there would be no difficulty in inducing manufacturers to lend their support, as it is they who would most directly profit from the results of the researches.

E. S. HODGSON.

NOTES.

A CORRESPONDENT in Petrograd gives us a rather gloomy account of the difficulties of carrying on scientific work or publications under the present conditions in Russia. He says:—"It is, in fact, now almost impossible to print here scientific works having small circulations, as the prices demanded by the compositors, printers, papermakers, and other workers connected with the production of books are 200–300 per cent. higher than they were in February, immediately before the Revolution. The results are beginning to be felt already—factories are being closed and the number of unemployed getting larger every day. Scientific work and teaching are at present almost impossible, as many of the institutes and universities are 'requisitioned' by irresponsible revolutionary organisations and troops; thus the Polytechnic Institute has been occupied since March 5 by about 2500 soldiers, and as the sanitary arrangements were never intended for such a number of people, having no ideas of sanitation, living and sleeping in the lecture- and drawing-halls, the shameful state of the institute may be imagined. All efforts to eject these unwelcome guests and those of other organisations have proved abortive, as the 'Provisional Government'

has no power to do it. Almost all courses of lectures are thus interrupted, and it is possible to conduct only some laboratory exercises and examinations. The students themselves take a large part in the different revolutionary organisations, and also make demands to have the direction and control of all the affairs of universities and institutes. The future of our seats of learning seems precarious indeed, as there are no visible signs of order succeeding the general anarchy, which, as of course you know from the daily papers, reigns everywhere supreme."

IT was suggested in NATURE of May 24 (p. 250) that the atmospheric conditions in this season of the year would probably favour observations on the transmission to this country of the sound of firing from the Western front. This anticipation has been realised, for on several occasions during the past six weeks the reports of continuous distant firing have been noticed in the London district. Dr. H. S. Allen, who previously recorded hearing the sounds from Chessington, informs us that sounds of bombardment were noticed by several observers at New Malden on June 3, 4, and 5. More recently he has heard the characteristic sounds on several occasions from Graffham Common, in West Sussex. The common lies between Petworth and Midhurst, on the north side of the South Downs. The reports are usually most distinct in the evening, and were heard very clearly on the still evenings of June 21 and 22. The German bombardment on the Nieuport front on July 10 accounts for the specially distinct reports heard from 5 p.m. on that date. The *Evening Standard* of July 11 states that between Horsham and West Grinstead the terrific gunfire in Flanders was heard more distinctly on the previous day than at any time during the war. The reports can be recognised readily by the frequency of their occurrence, the usual interval between successive reports being only a few seconds, and by the peculiar character of the concussion, which may be said to be felt rather than heard. According to a correspondent of the *Manchester Guardian* (July 12), persons on the higher ground to the north of London heard "the strange, heavy sound, that was like the muffled slamming of colossal doors." Further evidence with regard to the sound of the Messines mines is given in the first German account of the battle (quoted in the *Times* for July 14). The most marked feature of the explosion, according to an observer one kilometre from the northernmost mine, was the movement of the ground. The blow was accompanied "by a terrible crash, not so very loud, but so powerful and of such a kind as has never been heard after the explosion of the heaviest enemy shell or mine torpedo."

OWING to conditions resulting from the existing war, the International Exchange Service of the Smithsonian Institution, of Washington, is temporarily discontinued to almost all the countries of Europe and to India.

AT a meeting of the council of the Ray Society held on July 12, Dr. B. Daydon Jackson, vice-president, in the chair, the resignation as treasurer of Dr. DuCane Godman on account of ill-health was announced. The thanks of the council for his services during the past fourteen years were accorded to him, and Dr. S. F. Harmer was elected treasurer in his place.

DR. J. SCOTT KELTIE has retired from the editorship of the *Geographical Journal*, a position which he retained jointly with Mr. A. R. Hinks since his retirement from the secretaryship of the Royal Geographical Society two years ago. The *Journal* was founded in its present shape in 1893, a year after Dr. Keltie became assistant secretary and editor. On his retirement, after thirty-two years in the service of the society, Dr. Keltie has been elected a member of the council and awarded the society's Victoria medal for geographical research.

THE death is announced, at the age of seventy-eight, of Dr. J. M. Crafts. A graduate of the Lawrence Scientific School at Harvard, he studied chemistry afterwards at Freiberg, Heidelberg, and Paris. For many years he occupied a chair of chemistry in Cornell University, and from 1898 to 1900 he was president of the Massachusetts Institute of Technology. Since the latter date he had been engaged in chemical research in Boston. In 1885 Dr. Crafts was awarded the Jecker prize by the Paris Academy of Sciences, and was made a chevalier of the Legion of Honour. He had published researches upon organic silicium compounds, arsenic, ethers, studies in thermometry, catalytic reactions in concentrated solutions, etc.

PROF. E. G. HILL, principal of Muir College, University of Allahabad, died on June 28 at Naini Tal, India, at the age of forty-five. He was the son of the Rev. George Hill, D.D., of Nottingham, and was educated at Leeds, and later at Magdalen College, Oxford, whence he entered in 1895 the Indian Educational Service as professor of chemistry at Muir College. Shortly afterwards he became a fellow of Allahabad University, and the dean of the science faculty, and in 1913 was appointed principal of his college. He contributed a number of original papers on a variety of chemical subjects to the Transactions of the Chemical Society between the years 1903 and 1907. Among these may be mentioned:—Analysis of reh (natural alkaline salts); hydrolysis of ammonia salts by water; the coloured constituents of *Butea frondosa;* and a new colouring matter from *Nyclanthes arbor tristis.* He also acted as meteorologist to the United Provinces Government.

ORNITHOLOGISTS will learn with a mixture of regret and pride of the death of Mr. Eric B. Dunlop, who was killed in action on May 19. Born and bred in the Lake District—he was the eldest son of Mr. A. B. Dunlop, J.P., of Windermere—his innate love of birds found an exceptionally fine field for development, and he made the most of his opportunities, especially in regard to disappearing species, like the common buzzard, peregrine falcon, and raven. On the outbreak of war he was engaged upon a study of the nesting habits of birds in northern Manitoba, and coupled these investigations with a no less careful study of the fur-bearing mammals of Canada in regard to their seasonal changes and variation. In 1915 he decided to suspend his work and take his place in the fighting line, and accordingly enlisted in the 78th Canadian Grenadiers. But on his arrival in England he transferred to the Border Regiment, and was in France barely a month before he fell. We who are left have lost a comrade whom we could ill spare.

IT will be remembered that in NATURE for January 25 of this year Prof. Eugenio Rignano had a letter on a suggested "quadruple scientific Entente." The French original of this letter also appeared in the *Revue générale des Sciences* for January 30, and has given rise to a good deal of discussion. In the *Revue* for June 15 Prof. E. Gley fully agrees with Prof. Rignano about the malady of the German hegemony of scientific literature, but advances some criticisms on the proposed means of dealing with this evil. Prof. Gley's examples are naturally taken from the literature of that branch of science—physiology—with which he is most familiar; and he points out that the general tendency of nations is to make the publication of scientific work

more and more national. The attempt, chiefly apparent, it seems—at least so far as physiology is concerned—in Germany, to publish the work of scientific men of other nations in their own languages is, according to him, a danger of monopoly hidden under the cloak of apparent internationalisation. Further, we must allow for a sextuple Entente, to include the United States and Japan; and it seems that this would increase the difficulty of making the projected journals suffice for their task. Ententist organisation is certainly desirable, especially for year-books of analysis of published work, but Prof. Gley brings forward certain difficulties in the matter, which are, however, it would seem, not insurmountable. An Ententist organisation of detailed "handbooks" of science, something like the best German books, seems to Prof. Gley much more possible. A second part of the article is devoted to the development of laboratories in Germany, which has played a great part in Germany's scientific hegemony, and to the lessons that France might learn in this respect. In the *Revue* for April 15 M. Ch. Marie suggested the path to be followed in the organisation of scientific records and other publications by the countries of the Entente.

THE *Archives of Radiology and Electrotherapy* for June (vol. xxii., No. 1) contains an article by Mr. H. C. Gage on simplified X-ray methods. The necessity in the present war of coping swiftly with a maximum of cases at a minimum of expense has led to the evolution of new ideas and the modification of old methods. The localisation of foreign bodies and the radiography of the limbs for fractures are dealt with at length. Attention is directed to the use of rapid bromide paper, with which it is possible to make good radiographs if an intensification screen be employed for the deeper parts. By its use economy is effected and weight for transport reduced.

THE *Indian Journal of Medical Research* for April (vol. iv., No. 4) contains a number of valuable papers dealing with a variety of subjects—bacteriological studies of cholera-like microbes, vitality of the tubercle bacillus outside the body, *rôle* of the blood in ovulation in mosquitoes, a substitute for "nutrose" (pea-nut flour, ninety-four parts; casein, five parts; sodium carbonate, one part), etc. Lieut. Mackenzie Wallis, R.A.M.C., describes a new test for chlorine in drinking water. This consists of an acid solution of benzidine or tolidine, which yield a yellow colour with so little as 0·005 part of chlorine per million of water, and do not react with chlorides. The same author has also investigated the ability of chloramine-T to sterilise water for drinking purposes. One drop of a saturated aqueous solution of chloramine-T (about a 15 per cent. solution) will sterilise two litres of water, containing an excess of organic matter, in thirty minutes. Water so treated has no unpleasant taste or smell, as is the case when bleaching powder and other hypochlorites are used.

MR. J. ARTHUR HUTTON gives an account of the investigations (which he has now carried on for many years) into the life-history of the salmon in the *Salmon and Trout Magazine* for April. The method of "scale-reading" is that mainly employed, and the results apply particularly to the River Wye, but there is also a general discussion of the Billingsgate Market statistics, and a strongly urged plea for the general improvement of the system of collecting salmon statistics throughout the United Kingdom.

THE Madras Fisheries Bulletin, No. 11, consists of a description of the edible molluscs found on the shores of the Presidency. Mr. Jas. Hornell, the writer, gives good accounts of the occurrence and natural history of each of the principal species, and adds a figure for each of the more important animals. Except in the case of the poorer classes of coast dwellers, shell-fish are either despised or neglected as articles of food in India—that is, in comparison with the littoral fishing industries of Britain, France, and Japan, for instance. But it also appears to be the case that the larger and more valuable edible molluscs of other parts of the world are either very small or absent on Indian shores, and the suggestion is made that the indigenous supplies should be supplemented by the introduction and cultivation of more valuable species. The report is written from this point of view.

A BRIEF but felicitous series of notes on the breeding habits of the merlin appears in *British Birds* for July by Mr. E. R. Paton. These cover the whole period, from the first appearance of the merlin on an Ayrshire moor to the disappearance of the young, three in number. The male seems to have taken no part in incubation until near the time of hatching. Both parents took part in feeding the young, but while the female kept to the moor, the male hunted largely for food in a neighbouring wood. Though the nest was in the middle of a grouse-drive, yet no young game-bird was ever killed by either of the parent birds. Incubation lasted thirty days, and did not commence until the full clutch of three eggs was laid. The young were apparently able to fly by the end of July —that is to say, when about one month old.

MR. W. H. T. TAMS, in the July issue of the *Entomologists' Magazine*, directs attention to the fact that while the noctuid moth, *Euplexia lucipara*, taken in the British Isles differs but little, in external appearance, from specimens taken in Canada, yet in the structure of the genitalia of the males the differences are of a very striking character. Being now on active service with the Canadian Army Corps, Mr. Tams remarks that he is, for the present, quite unable to carry his investigations further into this subject, and hence appeals to entomologists who may have opportunities for work of this description to make a careful study of specimens of this species drawn from widely different areas of its range, which is considerable, since it is found all over Europe and Asia, as well as in North America. Such an inquiry, he contends, would afford valuable data as to the relation between these structural differences in the genitalia and the geographical distribution of the individuals.

To the *American Naturalist* for April (vol. li., No. 604) Dr. P. Hadley contributes a valuable paper on the flagellate genus Trichomonas, usually a harmless parasite in the intestine of various animal hosts. Dr. Hadley states that these organisms multiply exceedingly in the intestines of diarrhœic turkeys, penetrate the epithelium, and, invading the tissues of the host, become intracellular parasites living in the manner of sporozoa and playing a pathogenic *rôle* associated with the disease known as "blackhead." The author does not state definitely if he considers that the protozoal parasites hitherto recognised as the cause of "blackhead," and regarded as *Eimeria avium*, are in reality stages in the life-history of Trichomonas. The questions raised are of much interest, and call for further elucidation.

THAT legislation enacted to secure the extermination of "vermin" in response to popular clamour is ever dangerous we have always held. Australia is now learning this to her sorrow. For thirty years compulsory poisoning laws have been in force, and the *Scientific Australian* for March, which has just reached us, now complains that, as a result of these laws, the carrion hawks, crows, and native carnivora have been well-nigh wiped out. As a consequence, decaying bodies are left to be demolished by blow-flies, which

have now increased to such an appalling extent as to threaten the sheep on the runs with destruction, the animals becoming "fly-blown" and infested with the larvæ of this troublesome and dangerous insect. Similarly, the *Victorian Naturalist* for April relates that, for the last month or two, wheat buyers have been at their wits' end to protect the immense wheat stacks at country stations, especially in the Wimmera district, from mice, which have increased to an incredible extent. Most of the stacks have now been enclosed by sheets of galvanised iron, openings in which are left to correspond with kerosene tins, sunk in the ground, and partly filled with water. It is no uncommon occurrence to capture 10,000 mice in this way in a single night. At Minyip, recently, the catch for two nights weighed rather more than a ton. Australia would do well to follow the lead of Canada and the United States and appoint a Bureau of Economic Ornithology, which might also be charged with the task of inquiry into the status and usefulness, or otherwise, of such of the native carnivora as have escaped the unfortunate and ill-considered legislation which has brought about such disastrous results.

OF the many varieties of rice grown in India, some of the most interesting are the deep-water paddies grown in Orissa. Unlike other paddies, these deep-water forms, of which eight are known to be cultivated, can endure complete submergence for seven to ten days without sustaining any material damage. As the water rises the plants keep growing, maintaining their heads above water, and plants 10–15 ft. long have been measured, yielding at the same time a bumper harvest. The value of these paddies is that land which would otherwise be unutilised, since at crop seasons it is always under water, is found to be admirably suited to them, and a good return has been realised, owing to the introduction of these deep-water forms, from land which formerly was valueless. The account of the deep-water paddy of Orissa is given in the Journal of the Department of Agriculture, Bihar and Orissa, vol iv., p. 66, by Mr. E. L. Rout, Inspector of Agriculture, Cuttack.

THE *Times Trade Supplement* for July contains some interesting statistics as to the production of potash salts and products in the United States in 1916. The total production represented 8830 tons of potash, of which 5750 tons were obtained from mineral sources and 3080 tons from organic sources. Of the former, 3850 tons were obtained from natural salts or brines, and 1900 tons from alunite and silicate rocks, including recoveries from furnace-flue dusts. Of the potash from organic sources 1110 tons were obtained from kelp, 220 tons from pearl ash, and 1750 tons from miscellaneous industrial wastes. Canadian felspar, which has long been imported for use in pottery manufacture, is now imported by American manufacturers of fertilisers for use as potash manure. Portland cement works in Ontario are also producing potash as a by-product from the felspar used in making the cement. It is claimed that more than 80 per cent. of the potash of the felspar is recovered, and at a cost less than the freight charges paid on imported German potash before the war.

Two articles on the Near East in the July number of the *Geographical Journal* (vol. l., No. 1) are of special interest at the present time. The first, by Dr. E. W. G. Masterman, is on Palestine. Dr. Masterman, who knows Palestine well, and is secretary of the Palestine Exploration Fund, has no exaggerated views on the value of the country as a field for colonisation, and believes that the first needs of Palestine must be afforestation, irrigation, and the restoration of the terraces on the mountain-sides. Side by side with these efforts, he insists on an organised attack on the causes of the prevalent diseases—malaria, ophthalmia, dysentery, tuberculosis, and others. So far as present conditions go there is little room for increased population, and Dr. Masterman foresees no immediate opening for settlers on an extended scale after the war. The second paper is a long one, by Mr. H. C. Woods, on the Bagdad Railway and its tributaries. This paper deals also with the other railway lines and projects in Asia Minor, and with those in Syria so far as they act as feeders to the Bagdad line.

IN the Proceedings of the Cotteswold Naturalists' Field Club for 1916, p. 129, Mr. C. T. Gardiner gives a detailed study of the Silurian inlier on the east of the South Welsh coalfield between Usk and Pontypool. Dr. F. R. Cowper Reed describes and figures some new species from the area. The Wenlock Shales, it is urged, have a greater extension than appears on the Geological Survey map, while the Ludlow area is correspondingly reduced. A newly discovered outlier of Old Red Sandstone is indicated.

THE seventeenth report of the committee of the British Association on Photographs of Geological Interest appeared in 1910, and is now supplemented by the eighteenth report (1916), drawn up under the care of Prof. W. W. Watts and Prof. S. H. Reynolds. A large part of the interval has been unsuited for photographic work, especially along our coast-line, but valuable additions have been made from special localities, such as the series by Prof. Reynolds from the Carboniferous section in Burrington Combe, Somerset, following on his great Avon gorge series, and Mr. Godfrey Bingley's extensive studies of the Magnesian Limestone of Sunderland. Geologists desiring prints or lantern-slides from the negatives named in the lists now published are asked to communicate with the individual photographers, whose names and addresses are conveniently given.

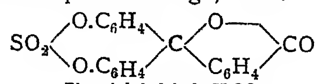
THE study of earthquakes in California is in the hands of the Weather Bureau in that State, assisted by observers at twelve first-class stations and by 314 "climatological observers." The results for the year 1916 are contained in an interesting paper by Mr. A. H. Palmer, contributed to the Seismological Society of America (Bulletin, vol. vii., 1917, pp. 1–17). The total number of earthquakes recorded during the year is sixty-six, which exceeds the number felt throughout the rest of the United States. None of them attained a destructive intensity, and two-thirds were so slight that they were felt at one station only. They occurred more frequently near the coast than in the interior, the region of greatest frequency being that about Monterey Bay. At San Francisco there was only one very slight shock. A peculiar feature of these earthquakes is the comparative absence of the earthquake-sound, which is mentioned in only one-fifth of the records. The earthquakes are attributed generally to movements along the well-known faults which traverse the State in a south-easterly direction, but the evidence is too scanty to enable the author to assign an earthquake to any particular fault. The State of California is one of the most interesting seismic regions, and it is to be hoped that the Weather Bureau will not remain content until the network of stations is greatly expanded, especially in the Owens Valley, the Imperial Valley, Humboldt County, and in the districts surrounding San Francisco and Monterey Bay.

Science for June 1 contains an interesting address by Prof. G. A. Miller on the function of mathematics in scientific research. It is rather discursive, but contains many striking epigrams; for instance, "I would be inclined to say that *modesty* is the attitude of mind which has contributed most powerfully to mathematical progress"; "Unless we

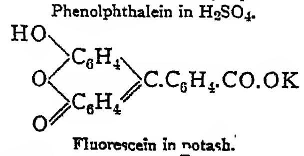
become like children in faith and fancy, we should not expect to add much that is fundamentally new to the kingdom of mathematics"; "Science is not primarily a grazing country; large tracts are suitable for agriculture and mining," and so on. One very remarkable discovery is referred to, namely, that the Maya people of Central America had a positional system of notation with various *different* signs for zero. While recognising the value of scientific organisation and the promotion of research, Prof. Miller gives the timely warning that "the greatest danger of research to-day is that its popularity tends to research hypocrisy." We may perhaps add to this that a good training in mathematics is one of the best preventives of hypocrisy and intellectual dishonesty of every kind. Finally, we may note that, in the speaker's opinion, mathematics is so far abreast of the time as to be ready to discuss the problems arising from our new views about the constitution of the physical world. This is good hearing, because Prof. Miller knows as well as any man alive the difference between analysis which deals with continuous variables and that which is concerned with discrete sets of elements.

A LECTURE on "Chemistry in Industry" was delivered at the Royal College of Science for Ireland, Dublin, on Tuesday, July 10, by Prof. Gilbert T. Morgan, who is now conducting a summer course in "Wool Dyes and Dyeing" under the auspices of the Department of Agriculture and Technical Instruction for Ireland. The relation between chemistry and the food-producing industries shows how essential it is to follow up every clue discovered in the laboratory in the hope that ultimately the discovery may prove to be of practical value. Chemistry is also intimately concerned in the production of cement, glass, and ceramic ware. Its services in the production of munitions of war are even more obvious. A remarkable characteristic of chemical industries is the tendency for the enterprises to become merged together, so that the waste products of one section become the raw material of another manufacture. It is only by encouraging this association of related industries that chemical manufacture can be conducted efficiently. Manufacturers of high explosives utilise their plant in the production of fine chemicals. Dye-producers drift into the manufacture of synthetic drugs and photographic chemicals.

DR. JAMES MOIR, in a paper read before the Royal Society of South Africa on "Colour and Chemical Constitution," describes the colour changes produced by substitution in some fifty derivatives of phenolphthalein and fluorescein. The most striking novelty in the paper is the discovery that when these substances are dissolved in concentrated sulphuric acid they give a coloration which is five times as intense as in alkali, and is produced by a band of lower wavelength, the frequency being half as fast again in sulphuric acid after allowing for a constant load due to combination of sulphuric acid with the oxygen of the dye. As, however, fluorescein in alkali and phenolphthalein in sulphuric acid give identical absorption bands, it is suggested that there is in each case a linking up of the phenolic rings, thus:—



Phenolphthalein in H_2SO_4.



Fluorescein in potash.

THE Journal of the Society of Engineers for May contains an account, by Lord Headley, of the goods clearing house system and machinery. It is now some eight or nine years since Mr. Gattie and Mr. Seamen introduced to public notice the extremely ingenious system of electro-magnetic machinery for dealing with heavy goods, and practical demonstrations have been given with full-sized machinery at the works of the New Transport Co., at Battersea. It is estimated that 97 per cent. of the life of railway wagons is spent standing still in sidings or shunting yards, and that 0.5 per cent. only is spent in running loaded. It is claimed that the goods clearing system would enable 80 per cent. of these wagons to be dispensed with. Official estimates of the surplus profits of the proposed London goods clearing house on its first year of working give a profit of 9,295,948*l.* on a capital outlay of 14,000,000*l.* It would appear that there are serious abuses due to railway mismanagement, and it is claimed that the new system would abate or do away with these. In brief, the system proposed is to collect all goods by motor lorries and to deliver them at one building instead of at many scattered stations. On arrival, the body of the lorry containing the goods is hoisted off by electric cranes, another body is dropped into place, and the lorry sets off immediately on another journey. The goods are sorted inside the house, according to their destination, by means of machinery, consisting of endless chains of trucks electrically controlled in such a way that goods may be picked up or deposited in any portion of the house. The control is effected from a central switch-board, and when the proper key is depressed the goods on the truck controlled are moved along and transferred to other trucks leading to other bays on the same floor, or up escalators to other floors. The goods are carried on trays, and the trucks are fitted with roller magnets which automatically transfer the trays at the proper instant. There is little doubt that such a system would go far to relieve the congestion in many London streets, and would dispense with a large amount—if not all—of the shunting operations at railway goods stations.

IT is announced that the "Dictionary of National Biography" has been presented to the University of Oxford by the family of the late Mr. George M. Smith, and will in future be published by the Oxford University Press.

OUR ASTRONOMICAL COLUMN.

THE RELATIVITY THEORY AND THE MOTION OF MERCURY'S PERIHELION.—The circumstance that especially attracted the attention of mathematicians to Einstein's new theory of relativity was the fact that it accounted for the whole excess of motion (43″ per century) of the perihelion of Mercury over that indicated by planetary theory. Dr. L. Silberstein, in a paper entitled "The Motion of the Perihelion of Mercury deduced from the Classical Theory of Relativity" (*Monthly Notices*, R.A.S., April, 1917), points out that it is not necessary for a relativity theory to explain the whole excess of Mercury's perihelion; part of it can reasonably be ascribed to the stratum of matter composing the zodiacal light. He himself prefers the older, simpler relativity theory, which he asserts to be unobjectionable in its foundations, and to accord well with observation in the field of physics. He notes that it would not indicate the bending of a ray of light in a gravitational field, as Einstein's does. It is hoped that this critical experiment may be made at the total solar eclipse of May, 1919.

In the classical relativity theory, as in Newtonian mechanics, the rate of increase of momentum mv is

equal to the force N. But the inertia coefficient m is not a constant, but a function of velocity, "precisely as the familiar transversal mass of an electron."

He proceeds to investigate a formula that will account for the whole of Mercury's excess. Putting β=velocity of planet/velocity of light, and $\gamma=(1-\beta^2)^{-\frac{1}{2}}$, *i.e.* $1+\frac{1}{2}\beta^2$, then if M_0, m_0 be rest-masses of sun and planet, $m=m_0\gamma$. Assuming for the law of force $M_0 m_0 \gamma^{n-1}/r^2$, or its equivalent, $M_0 m \gamma^{n-2}/r^2$, where n is an arbitrary constant, he shows that the value 6 for n gives the centennial excess 43″ for Mercury and 8·6″ for Venus. "Why n is just 6 I do not know. But as little do we know why the exponent of r is -2."

ANOMALOUS DISPERSION.—By the use of the electric furnace Dr. A. S. King has found it possible to investigate the anomalous dispersion of the more refractory elements, under conditions which can be kept well controlled (*Astrophysical Journal*, vol. xlv., p. 254). The amount of anomalous dispersion shown by a line is proportional to its intensity in absorption, provided the vapour absorbing the line in question has the requisite non-uniform distribution equivalent to a prism. Lines which show a strong anomalous dispersion at a low temperature frequently show refraction in the opposite direction when the temperature is raised, thus indicating that the vapour prism absorbing such lines has been inverted. When two elements with different melting points are mixed, the direct and inverted effects may occur simultaneously, and a similar result has been found in the case of a single element for lines which require different temperatures for their production. Thus the blue line of calcium, λ 4227, may show the inverted effect, while at the same time the H and K lines show anomalous dispersion of the regular type. Each element thus has the capacity to give its own anomalous dispersion independently of other vapours which may be present, and a similar relation holds for particles of the same element emitting lines of different character. No evidence was found for mutual repulsion of close lines, one of which is in a condition to show large anomalous dispersion, and it would appear that the theoretical effect is too small to be detected by laboratory methods now available.

THE VARIABLE STAR *u* HERCULIS.—The conclusion that *u* Herculis is a variable of the β Lyræ type has been verified by W. Dziewulski, from observations made with a 4-in. comet-seeker at the Cracow Observatory (*Astronomische Nachrichten*, No. 4887). The observations indicate no correction to Hertzsprung's period of 2·051027 days. At principal and secondary minima the magnitudes are 5·51 and 5·17 respectively, while at the two maxima the magnitude is 5·01. The light-curve is slightly unsymmetrical.

THE FUTURE OF THE DISABLED.

THE problem of the disabled sailor and soldier is one of great magnitude. Fortunately, it is only a small minority of the sick and wounded that is doomed to total disablement and to become the helpless subjects of their neighbours' loving care for the rest of their lives. For the majority hope and anticipation remain in varying degree—hope of restoration, more or less complete, of the maimed body, and anticipation of a life of some amount of independence and usefulness in the future. The latter is to be sought in a course of adequate treatment and training which is now receiving careful attention.

The disabled are frequently under the mistaken apprehension that if they again become industrially efficient the pensions awarded to them as disabled men will be taken away or diminished. This idea is quite devoid of foundation; the pension, once awarded, can never be withdrawn or reduced.

Those who wish to help the disabled man can often best aid him by enabling him to obtain a clear idea of the various openings that lie before him. The organisation now in being for training the disabled man, for opening to him a satisfactory place in life, and incidentally for carrying his cure a stage further, is not yet complete, but for some time past it has been far more effective than is commonly known, and it is steadily growing.

In a new periodical entitled *Recalled to Life*,[1] the first number of which was issued in June, the problem of the disabled is, and will be, considered in all its aspects

Among the contents there is a memorandum prepared by Sir Alfred Keogh, Director-General, Army Medical Service, on the treatment of the disabled. Col. Sir Robert Jones discusses orthopædic surgery in its relation to war. With regard to treatment, it is important to note that when surgery, massage, exercises, electrical treatment, and other curative measures have carried the cure so far as it will go, manual training will frequently carry it a stage further, and when the patient finds that he is really capable of doing some useful and remunerative work he acquires a new zest for life.

The after-care of the blind is provided for at St. Dunstan's under the guidance of Sir Arthur Pearson. In the education of the blind two cardinal factors have to be appreciated. First of all, those who have lost their sight must be *taught* to be blind, and, having realised their state, they must be re-educated and trained. The principal occupations and industries taught at St. Dunstan's are the reading of Braille, typewriting, cobbling, mat-making, basket-making, and joinery. The men acquire these industries in a quarter the time that is generally supposed to be necessary to teach a blinded man a trade. The explanation of this speedy training is to be sought, first, in the employment of blind teachers, and, secondly, in the adoption of short working hours (9.30 to 12 and 2.30 to 4.30). The whole outlook of a man becomes different when he finds himself in the hands of a teacher who labours under the same disability as himself. Working under the handicap of blindness imposes a mental strain very much greater than might be imagined, and the shortness of the working day, paradoxical as at first it may seem, is one of the principal reasons for the remarkable speed with which handicrafts are acquired at St. Dunstan's. The subject of pensions is dealt with very fully in another article by Capt. Basil Williams, and other important papers and reports appear in this journal, which is illustrated by many plates showing disabled men practising the handicrafts they have learnt. Finally, a tabulated list is given of training classes for the disabled.

We commend *Recalled to Life* to the serious attention of all those who are aiding in the great work of succouring the disabled and of helping them to become again useful members of the State.

REFRACTORIES USED IN THE IRON AND STEEL INDUSTRY.

ALTHOUGH the Faraday Society held a general discussion on refractories so recently as November last, prominence was given to this matter in so far as it affects the requirements of the iron and steel industry at the May meeting of the Iron and Steel Institute. The subject was very ably introduced by Mr. Cosmo

[1] Editor: Lord Charnwood. Assistant Editor: Everard Cotes. (London John Bale, Sons, and Danielsson, Ltd.) Price 2s. net.

Johns, the furnace manager of Vickers, Ltd., and took the form of a compact statement of the properties of the refractories in general use and the urgent need for systematic research work along certain lines.

In any given metallurgical process the ideal refractory must be infusible and non-volatile; its volume must not vary during the temperature fluctuations that occur; it must be chemically inert; it must have sufficient structural strength and be a non-conductor of heat. No such substance is known. Whether any such material can be prepared only the future will show. Up to the present the refractories actually used are simply the best approximations to the above ideal, which have been reached almost entirely by experience gained by empirical trials spread over a century or more. As Mr. Johns observes:—"The methods employed to-day represent the survival of the fittest by the searching test of commercial success, but it by no means follows that they represent the best obtainable"; and, further:—"The art has been so long in front of the science of the refractory industry that the most urgent need at the present is for an expression in terms of scientific precision of the most successful practice in manufacturing the refractory product and of the physico-chemical changes which take place when they are used."

As regards the materials available, leaving aside carbon and its compounds with silicon, which have only a limited application, they are chiefly the oxides, silica, alumina, lime, magnesia, and chromium oxide, or compounds of these with oxides of iron, sodium and potassium, and traces of other substances, regarded as impurities, some of which may act as catalysts. The raw materials for coke-oven bricks, blast-furnace bricks, and casting ladle nozzles are the fireclays, most of which were obtained from home sources before the war. Again, quartzite, the raw material of silica bricks, used in acid open-hearth furnace construction, is entirely derived from home supplies. On the other hand, magnesite, the raw material of basic refractories used in basic open-hearth and electric furnace construction, is nearly all imported, either in the raw or calcined state. Chromite, the raw material of bricks used where a neutral refractory is required, which will not have a reducing action such as the carbon refractories exert, has also to be obtained from abroad. The materials available are therefore strictly limited, and they never occur in a state of purity in Nature. Their manufacture into finished refractories involves a succession of processes which vary according to the purpose for which they are intended, and the final product is always a mineral aggregate, often of great complexity. In consequence of this the refractory does not possess a melting point, but rather a softening range spread over a considerable temperature interval, which results finally in the material failing to perform its functions. It is essential that any refractory should be "burnt" at a temperature somewhat higher than it will be called upon to endure in practice; otherwise serious difficulties arising from volume changes, especially shrinkages, will be encountered.

Texture and porosity determine very largely the suitability or otherwise of refractories for particular purposes. The relative size of the grains, and the extent of the surface exposed by the more resistant constituents to the others used as a bond or matrix, are most important factors in contributing to the ability of the material to perform useful service. Another point of importance is the influence of mass in promoting or retarding inversions. Some inversions occur almost instantaneously once the critical temperature has been reached, but with others marked hysteresis occurs. Porosity must always occur when the refractory is composed of more than one constituent, and where their chief volume changes are dissimilar, or occur at different temperatures. Little is known of the effect of porosity on properties, but it is obvious that it permits the deposition of extraneous material in the interior of the bricks and renders them permeable to gases.

Both tenacity and compressive strength are important properties of refractories at high temperatures. Abrasion is caused by the movement of solid substances while in contact with their heated surfaces; erosion is due to the passage of dust-laden gases at high velocities. Almost nothing is known as to the conditions which may be expected to retard abrasion and erosion, and in what way they are related to the mechanical properties of the materials. There is accordingly urgent need for the accurate determination of tenacity and compressive strength, over wide ranges of temperature, of the chief refractories under both oxidising and reducing conditions. Not less important is the property of resistance to corrosion caused either by slags or gases. The effects of acid slags on basic refractories, and of basic slags on acid refractories, are well known. Less familiar, except to experts, are the instances of gas corrosion of the silica bricks in the gas ports and uptakes of open-hearth furnaces due to the alternating passage of oxidising and reducing gases with the resulting formation of fusible silicates.

It is satisfactory to be able to record that the Geological Survey is preparing a memoir of the mineral resources of this country, and is dealing specially with refractories. Mr. Johns points out that the concentration and purification of these, their proximate and ultimate analysis, their mineralogical description, and their thermal analysis are all matters requiring scientific investigation. Pioneer work has already been carried out under Dr. Mellor at the Pottery Laboratory, Stoke-on-Trent. Researches are also in contemplation, or have been initiated, at various universities and technical institutions in the country.

H. C. H. C.

THE COMPLEXITY OF THE CHEMICAL ELEMENTS.[1]

THE elements of the chemist are now known to be complex in three different senses. In the first sense the complexity is one that concerns the general nature of matter, and therefore of all the elements in common to a greater or less degree. It follows from the relations between matter and electricity which have developed gradually during the past century as the result of experiments made and theories born within the four walls of this institution. Associated initially with the names of Davy and Faraday, they have only in these days come to full fruition as the result of the very brilliant elucidation of the real nature of electricity by your distinguished professor of physics, Sir Joseph Thomson. Such an advance, developing slowly and fitfully with long intervals of apparent stagnation, needs to be reviewed from generation to generation, disentangled from the undergrowth that obscures it, and its clear conclusions driven home. This complexity of the chemical elements is a consequence of the condition that neither free electricity nor free matter can be studied alone, except in very special phenomena. Our experimental knowledge of matter in quantity is necessarily confined to the complex of matter and electricity, which constitutes the material world. This applies even to the "free" elements of the chemist, which in reality are no more free then than they are in their compounds. The difference is

[1] Discourse delivered at the Royal Institution on Friday, May 18, by Prof. Frederick Soddy, F.R.S.

merely that whereas in the latter the elements are combined with other elements, in the so-called free state they are combined with electricity. I shall touch but briefly on this first aspect, as in principle it is now fairly well understood. But its consistent and detailed application to the study of chemical character is still lacking.

The second sense in which the elements, or some of them at least, are known now to be complex has, in sharp contrast to the first, developed suddenly and startlingly from the recognition in radio-active changes of different radio-elements, non-separable by chemical means, now called isotopes. The natural corollary of this is that the chemical element represents rather a type of element, the members of the type being only chemically alike. Alike they are in most of those properties which were studied prior to the last decade of last century, and probably due, as we now think, to the outer shells of the atom—so alike that all the criteria hitherto relied upon by the chemist as being the most infallible and searching would declare them to be identical. The apparent identity goes even deeper into the region reached by X-ray spectrum analysis, which fails to distinguish between them. The difference is found only in that innermost region of all, the nucleus of the atom, of which radio-active phenomena first made us aware.

But, though these phenomena pointed the way, and easily showed to be different what the chemist and spectroscopist would have decided to be identical, they did more. They showed that although the finer and newer criteria relied upon by the chemist in his analysis of matter must of necessity fail in these cases, being ultimately electrical in character, yet the difference should be obvious in that most studied and distinctive characteristic of all—the criterion by which Dalton first distinguished the different kinds of atoms —the atomic weight. Those who have devoted themselves to the exact determination of these weights have now confirmed the difference in two separate cases, which, in the absence of what perhaps they might regard as "preconceived notions," they were unable to discover for themselves. This is the experimental development to which I wish more especially to direct your attention It indicates that the chemical analysis of matter is, even within its own province, superficial rather than ultimate, and that there are indefinitely more distinct elements than the ninety-two possible types of element accommodated by the present periodic system.

The third sense in which the elements are known to be complex is that which, in the form of philosophical speculations, has come down to us from the ancients, which inspired the labours of the alchemists of the Middle Ages, and, in the form of Prout's hypothesis, has reappeared in scientific chemistry. It is the sense that denies to Nature the right to be complex, and from the earliest times, faith outstripping knowledge, has underlain the belief that all the elements must be built up of the same primordial stuff. The facts of radio-active phenomena have shown that all the radio-elements are indeed made up out of lead and helium, and this has definitely removed the question from the region of pure speculation. We know that helium is certainly a material constituent of the elements in the Proutian sense, and it would be harmless, if probably fruitless, to anticipate the day of fuller knowledge by atom building and unbuilding on paper. Apart altogether from this, however, the existence of isotopes, the generalisation concerning the periodic law that has arisen from the study of radio-active change on one hand and the spectra of X-rays on the other, and experiments on the scattering of α particles by matter do give us for the first time a definite conception as to what constitutes the difference between one element and another. We can say how gold would result from lead or mercury, even though the control of the processes necessary to effect the change still eludes us. The nuclear atom proposed by Sir Ernest Rutherford, even though, admittedly, it is only a general and incomplete beginning to a complete theory of atomic structure, enormously simplifies the correlation of a large number of diverse facts. This and what survives of the old electronic theory of matter, in so far as it attempted to explain the periodic law, will therefore be briefly referred to in conclusion.

The Free Element a Compound of Matter and Electricity.

Although Davy and Faraday were the contemporaries of Dalton, it must be remembered that it took chemists fifty years to put the atomic theory on a definite and unassailable basis, so that neither of these investigators had the benefit of the very clear view we hold to-day. Davy was the originator of the first electrochemical theory of chemical combination, and Faraday's dictum, "The forces of chemical affinity and electricity are one and the same," it is safe to say, inspires all the modern attempts to reduce chemical character to a science in the sense of something that can be measured quantitatively, as well as expressed qualitatively. Faraday's work on the laws of electrolysis and the discovery that followed from it when the atomic theory came to be fully developed, that all monovalent atoms or radicles carry the same charge, that divalent atoms carry twice this charge, and so on, can be regarded to-day as a simple extension of the law of multiple proportions from compounds between matter and matter to compounds between matter and electricity. Long before the electric charge had been isolated, or the properties of electricity divorced from matter discovered, the same law of multiple proportions which led, without any possibility of escape, to an atomic theory of matter led, as Helmholtz pointed out in his well-known Faraday lecture to the Chemical Society in this theatre in 1881, to an atomic theory of electricity.

The work of Hittorf on the migration of ions, the bold and upsetting conclusion of Arrhenius that in solution many of the compounds hitherto regarded as most stable exist dissociated into ions, the realisation that most of the reactions that take place instantaneously and are utilised for the identification of elements in chemical analysis are reactions of ions rather than of the element in question, made very familiar to chemists the enormous difference between the properties of the elements in the charged and in the electrically neutral state.

More slowly appreciated and not yet perhaps sufficiently emphasised was the unparalleled intensity of these charges in comparison with anything that electrical science can show, which can be expressed tritely by the statement that the charge on a milligram of hydrogen ions would raise the potential of the world to 100,000 volts. Or, if we consider another aspect, and calculate how many free hydrogen ions you could force into a bottle without bursting it, provided, of course, that you could do so without discharging the ions, you would find that were the bottle of the strongest steel—the breech of a gun, for example—it would burst, by reason of the mutual repulsion of the charges, before as much was put in as would, in the form of hydrogen gas, show the spectrum of the element in a vacuum tube.

Then came the fundamental advances in our knowledge of the nature of electricity, its isolation as the electron, or atom of negative electricity, the great extension of the conception of ions to explain the conduction of electricity through gases, the theoretical reasoning, due in part to Heaviside, that the electron

must possess inertia inversely proportional to the diameter of the sphere on which it is concentrated by reason of the electromagnetic principles discovered by Faraday, leading to the all-embracing monism that all mass may be of electromagnetic origin.

This put the coping-stone to the conclusion that the elements as we apprehend them in ordinary matter are always compounds. In the "free" state they are compounds of the element in multiple atomic proportions with the electron. The ions, which are the real chemically uncombined atoms of matter, can no more exist free in quantity than can the electrons.

The compound may be individual as between the atom and the electron, or it may be statistical, affecting the total number merely of the opposite charges, and the element presumably will be an insulator or conductor of electricity accordingly. Analogously, with compounds, the former condition applies to unionised compounds, such as are met with in the domain of organic chemistry, or ionised, as in the important classes of inorganic compounds, the acids, bases, and salts. Just as the chemist has long regarded the union of hydrogen and chlorine as preceded by the decomposition of the hydrogen and chlorine molecule, so he should now further regard the union itself as a decomposition of the hydrogen atom into the positive ion and the negative electron and a combination of the latter with the chlorine atom.

One of the barriers to the proper understanding and quantitative development of chemical character from this basis is perhaps the conventional idea derived from electrostatics that opposite electric charges neutralise one another. In atomic electricity or chemistry, though the equality of the opposite charges is a necessary condition of existence, there is no such thing as neutralisation or the electrically neutral state. Every atom being the seat of distinct opposite charges, intensely localised, the state of electric neutrality can apply only to a remote point outside it, remote in comparison with its own diameter. We are getting back to the conception of Berzelius with some possibility of understanding it, that the atom of hydrogen, for example, may be strongly electro-positive and that of chlorine strongly electro-negative, with regard to one another, and yet each may be electrically neutral in the molar sense. Some day it may be possible to map the electric field surrounding each of the ninety-two possible types of atom over distances comparable with the atomic diameter. Then the study of chemical character would become a science in Kelvin's sense, of something that could be reduced to a number. But the mathematical conceptions and methods of attack used in electrostatics for macroscopic distances are ill-suited for the purposes of chemistry, which will have to develop methods of its own.

We have to face an apparent paradox that the greater the affinity that binds together the material and electrical constituents of the atom, the less is its combining power in the chemical sense. In other words, the chemical affinity is in inverse ratio to the affinity of matter for electrons. The helium atom offers a very simple and instructive case. Helium is non-valent and in the zero family, possessing absolutely no power of chemical combination that can be detected. Yet we know the atom possesses two electrons, for in radioactive change it is expelled without them as the α-particle. The discharge of electricity through it and positive-ray analysis show that the electrons, or certainly one of them, are detachable by electric agencies, although not by chemical agencies. One would expect helium to act as a diad, forming helides analogous to oxides.

Prof. Armstrong for long advocated the view that these inert gases really are endowed with such strong chemical affinities that they are compounds that have never been decomposed. They certainly have such strong affinities for electrons that the atom, the complex of the + ion and electrons, cannot be decomposed chemically. Yet in this case, where the affinity of the matter for the electron is at a maximum, the chemical combining power is absent.

These gases seem to furnish the nearest standard we have to electric neutrality in the atomic sense. The negative charge of the electrons exactly satisfies the positive charge of the matter, and the atomic complex is chemically, because electrically, neutral. In the case of the electro-positive elements, hydrogen and the alkali metals, one electron more than satisfies the positive charge on the ion, and so long as the equality of opposite charges is not altered the electron tries to get away. In the case of the electro-negative elements, such as the halogens, the negative charge, though equal presumably to the positive, is not sufficient to neutralise the atom. Hence these groups show strong mutual affinity, one having more and the other less negative electricity than would make the system atomically neutral like helium. The electron explains well the merely numerical aspect of valency. But chemical combining power itself seems to require the idea that equal and opposite charges in the atomic sense are only exactly equivalent in the case of the inert gases. None of these ideas are now new, but their consistent application to the study of chemical compounds seems curiously to hang fire, as though something were still lacking.

It is so difficult for the chemist consistently to realise that chemical affinity is due to a dissociating as well as to a combining tendency, and is a differential effect. There is only one affinity, probably, and it is the same as that between oppositely charged spheres. But, atomic charges being enormous, and the distances over which they operate in chemical phenomena being minute, this affinity is colossal, even in comparison with chemical standards. What the chemist recognises as affinity is due to relatively slight differences between the magnitude of the universal tendency of the electron to combine with matter in the case of the different atoms. Over all is the necessary condition that the opposite charges should be equivalent, but this being satisfied, the individual atoms display the tendencies inherent in their structure, some to lose, others to gain electrons, in order, as we believe from Sir Joseph Thomson's teaching, to accommodate the number of electrons in the outermost ring to some definite number. Chemical affinity needs that some shall lose as well as others gain. Chemical union is always preceded by a dissociation. The tendency to combine, only, is specific to any particular atom, but the energy and driving power of combination are due to the universal attraction of the + for the − charge, of matter for the electron.

The Electrical Theory of Matter.

Another barrier that undoubtedly exists to the better appreciation of the modern point of view, even among those most willing to learn, is the confusion that exists between the earlier and the present attempt to explain the relation between matter and electricity. We know negative electricity apart from matter as the electron. We know positive electricity apart from the electron, the hydrogen ion, and the radiant helium atom, or α-particle of radio-active change, for example, and it *is* matter in the free, or electrically uncombined, condition. Indeed, if you want to find matter free and uncombined, the simple elementary particle of matter in the sense of complexity being discussed, you will go, paradoxically, to what the chemist terms a compound rather than to that which he terms the free element. If this compound is ionised completely it constitutes the nearest approach to matter in the free

state. Thus all acids owe their common acidic quality to really free hydrogen, the hydrogen ion, a particle more different from the hydrogen atom than the atom is from the hydrogen molecule. Positive electricity is thus emphatically not the mere absence of electricity, and any electrical theory of matter purporting to explain matter in terms of electricity does so by the palpable sophistry of calling two fundamentally different things by the same name. The dualism remains, whether you speak of matter and electricity, or of positive and negative electricity, and the chemist would do well to stick to his conception of matter until the physicist has got a new name for positive electricity which will not confuse it with the only kind of electricity that can exist apart from matter.

On the other hand, the theory of the electromagnetic origin of mass or inertia is a true monism. It tries to explain consistently two things—the inertia of the electron and the inertia of matter—by the same cause. The inertia of the former being accounted for by the well-known electromagnetic principles of Faraday, by the assumption that the charge on the electron is concentrated into a sphere of appropriate radius, the two thousand-fold greater inertia of the hydrogen ion, for example, can be accounted for by shrinking the sphere to one two-thousandth of the electronic radius.

But the electrical dualism remains completely unexplained. Call the electron E and the hydrogen ion H. The facts are that two E's repel one another with the same force and according to the same law as two H's repel each other, or as an H attracts an E. These very remarkable properties of H and E are not explained by the explanation of the inertia. Are E and H made up of the same stuff or of two different stuffs? We do not know, and certainly have no good reason to assume that matter *minus* its electrons is made of the same thing as the electron. We have still to reckon with two different things.

The Chemical Elements not necessarily Homogeneous.

I pass now to the second and most novel sense in which the elements, or some of them at least, are complex. In their discovery of new radio-active elements M. and Mme. Curie used radio-activity as a method of chemical analysis precisely as Bunsen and Kirchhoff, and later Sir William Crookes, used spectrum analysis to discover cæsium and rubidium, and thallium. The new method yielded at once, from uranium minerals, three new radio-elements—radium, polonium, and actinium. According to the theory of Sir Ernest Rutherford and myself, these elements are intermediate members in a long sequence of changes of the parent element uranium. In a mineral the various members of the series must co-exist in equilibrium, provided none succeed in escaping from the mineral, in quantities inversely proportional to their respective rates of change, or directly proportional to their periods of average life. Radium changes sufficiently slowly to accumulate in small but ponderable quantity in a uranium mineral, and so it was shown to be a new member of the alkaline-earth family of elements, with atomic weight 226·0, occupying a vacant place in the periodic table. Polonium changes 4500 times more rapidly, and can only exist to the extent of a few hundredths of a milligram in a ton of uranium mineral. Actinium also, though its life period is still unknown, and very possibly is quite long, is scarce for another reason: that it is not in the main line of disintegration, but in a branch series which claims only a few per cent. of the uranium atoms disintegrating. In spite of this, polonium and actinium have just as much right to be considered new elements probably as radium has. Polonium has great resemblances in chemical character both to bismuth and tellurium, but was separated from the first by Mme. Curie, and from the second by Marckwald. In the position it occupies as the last member of the sulphur group, bismuth and tellurium are its neighbours in the periodic table. Actinium resembles the rare-earth elements, and most closely lanthanum, but an enrichment of the proportion of actinium from lanthanum has been effected by Giesel. The smallness of the quantities alone prevents their complete separation in the form of pure compounds, as was done for radium.

The three gaseous members, the emanations of radium, actinium, and thorium, were put in their proper place in the periodic table almost as soon as radium was, for, being chemically inert gases, their characterisation was simple. They are the last members of the argon family, and the fact that there are three of about the same atomic weight was probably the first indication, although not clearly appreciated, that more than one chemical element could occupy the same place in the periodic table.

The extension of the three disintegration series proceeded apace, new members were being continually added, but no other new radio-element—new, that is, in possessing a new chemical character—was discovered. The four longest lived to be added, radio-lead, or radium-D, as it is now more precisely termed, and ionium in the uranium series, and mesothorium-I and radiothorium in the thorium series, could not be separated from other constituents always present in the minerals—radium-D from lead, ionium and radiothorium from thorium, and mesothorium-I from radium. An appreciable proportion of the radioactivity of a uranium mineral is due to radium-D and its products, and its separation would have been a valuable technical achievement, but though many attempts have been made, this has never been accomplished, and, we know now, probably never will be.

Seven years ago it was the general opinion in the then comparatively undeveloped knowledge of the chemistry of the radio-elements that there was nothing especially remarkable in this. The chemist is familiar with many pairs or groups of elements the separation of which is laborious and difficult, and the radiochemist had not then fully appreciated the power of radio-active analysis in detecting a very slight change in the proportions of two elements, one or both of which were radio-active. The case is not at all like that of the rare-earth group of elements, for example, in which the equivalent or atomic weight is used as a guide to the progress of the separation. Here, the total difference in the equivalent of the completely separated elements is only a very small percentage of the equivalent, and the separation must already have proceeded a long way before it can be ascertained.

Human nature plays its part in scientific advances, and the chemist is human like the rest. My own views on the matter developed with some speed, when, in 1910, I came across a new case of this phenomenon. Trying to find out the chemical character of mesothorium-I, which had been kept secret for technical reasons, I found it to have precisely the same chemical character as radium, a discovery which was made in the same year by Marckwald, and actually first published by him. I delayed my publication some months to complete a very careful fractional crystallisation of the barium-radium-mesothorium-I chloride separated from thorianite. Although a great number of fractionations were performed, and the radium was enriched, with regard to the barium, several hundred times, the ratio between the radium and mesothorium-I was, within the very small margin of error possible in careful radio-active measurements, not affected by the process. I felt justified in concluding from this case, and its analogy with several other similar cases then known, that radium and meso-

thorium-I were non-separable by chemical processes, and had a chemical character not merely like, but identical. It followed that some of the common elements might similarly be mixtures of chemically identical elements. In the cases cited the non-separable pairs differ in atomic weight from two to four units. Hence the lack of any regular numerical relationships between the atomic weights would, on this view, follow naturally (Trans. Chem. Soc., 1911, vol. xcix., p. 72). This idea was elaborated in the Chemical Society's Annual Report on Radio-activity for 1910, in the concluding section summing up the position at that time. This was, I think, the beginning of the conception of different elements, identical chemically, which later came to be termed "isotopes," though it is sometimes attributed to K. Fajans, whose valuable contributions to radio-activity had not at that date commenced, and whose first contribution to this subject did not appear until 1913.

In the six or seven years that have elapsed the view has received complete vindication. Really three distinct lines of advance converged to a common conclusion, and, so far as is possible, these may be disentangled. First there has been the exact chemical characterisation from the new point of view of every one of the members of the three disintegration series with lives over one minute. Secondly came the sweeping generalisations in the interpretation of the periodic law. Lastly there has been the first beginnings of our experimental knowledge of atomic structure, which got beyond the electronic constituents and at the material atom itself.

In pursuance of the first, Alexander Fleck, at my request, commenced a careful systematic study of the chemical character of all the radio-elements known, of which our knowledge was lacking or imperfect, to see which were, and which were not, separable from known chemical elements. Seldom can the results of so much long and laborious chemical work be expressed in so few words. Every one that it was possible to examine was found to be chemically identical either with some common element or with another of the new radio-elements. Of the more important characterisations, mesothorium-II was found to be non-separable from actinium, radium-A from polonium, the three B-members and radium-D from lead, the three C-members and radium-E from bismuth, actinium-D and thorium-D from thallium. These results naturally took some time to complete, and became known fairly widely to others working in the subject before they were published, through A. S. Russell, an old student, who was then carrying on his investigations in radio-activity in Manchester. Their interpretation constitutes the second line of advance.

Before that is considered, it may first be said that every case of chemical non-separability put forward has stood the test of time, and all the many skilled workers who have pitted their chemical skill against Nature in this quest have merely confirmed it. The evidence at the present day is too numerous and detailed to recount. It comes from sources, such as in the technical extraction of mesothorium from monazite, where one process is repeated a nearly endless number of times; from trials of a very great variety of methods, as, for example, in the investigations on radium-D and lead by Paneth and von Hevesy; it is drawn from totally new methods, as in the beautiful proof by the same authors of the electrochemical identity of these two isotopes; it is at the basis of the use of radio-active elements as indicators for studying the properties of a common element isotopic with them, at concentrations too feeble to be otherwise dealt with; and from large numbers of isolated observations, as well as prolonged systematic researches. One of the finest examples of the latter kind of work, the Austrian researches on ionium, will be dealt with later. The most recent, which appeared last April, is by T. W. Richards and N. F. Hall, who subjected lead from Australian carnotite, containing therefore radium-D, to more than a thousand fractional crystallisations in the form of chloride without appreciably altering the atomic weight or the β activity. So that it may be safely stated that no one who has ever really tested this conclusion now doubts it, and, after all, they alone have a right to an opinion.

This statement of the non-separability by chemical methods of pairs or groups of elements suffers perhaps from being in a negative form. It looks too much like a mere negative result, a failure, but in reality it is one of the most sweeping positive generalisations that could be made. Ionium, we say, is non-separable from thorium, but every chemist knows thorium is readily separated from every other known element. Hence one now knows every detail of the chemistry of the vast majority of these new radio-elements by proxy, even when their life is to be measured in minutes or seconds, as completely as if they were obtainable, like thorium is, by the ton. The difference it makes can only be appreciated by those who have lived through earlier days, when, in some cases, dealing with the separation of radio-constituents from complex minerals, after every chemical separation one took the separated parts to the electroscope to find out where the desired constituent was.

As the evidence accumulated that we had to deal here with something new and fundamental, the question naturally arose whether the spectrum of isotopes would be the same. The spectrum is known, like the chemical character, to be an electronic rather than mass phenomenon, and it was to be expected that the identity should extend to the spectrum. The question has been tested very thoroughly, by A. S. Russell and R. Rossi in this country, and by the Austrian workers at the Radium Institut of Vienna, for ionium and thorium, and by numerous workers for the different isotopes of lead. No certain difference has been found, and it may be concluded that the spectra of isotopes are identical. This identity probably extends to the X-ray spectra, Rutherford and Andrade having shown that the spectrum of the γ-rays of radium-B is identical with the X-ray spectrum of its isotope lead.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Merthyr Education Committee has accepted with thanks an offer from Mr. H. Seymour Berry to equip a technical mining and engineering institute at a cost of 10,000*l.*, in commemoration of the part his late father, ex-Alderman J. M. Berry, had taken in the public life of the town.

THE trustees of the Beit Fellowships for Scientific Research, which were founded and endowed four years ago by Mr. Otto Beit in order to promote the advancement of science by means of research, have recently elected Mr. Leslie Hartshorn to a fellowship. Mr. Hartshorn will carry out his research in the Imperial College at South Kensington.

A CONFERENCE on new ideals in education is to be held at Bedford College, Regent's Park, London, on August 14-21. The inaugural address will be delivered by the President of the Board of Education, Mr. H. A. L. Fisher, on August 15 at 10 a.m. Among the subjects and speakers we notice the following: On August 15, Mr Frank Roscoe, on the mind of youth; on August 16, Prof. Bompas Smith, on problems of the urban continuation school; on

August 17, Mr. R. G. Hatton, on the problem of the rural continuation school; and on August 18, Mr. W. G. W. Mitchell, on some new ideals in geometry teaching, and Miss Dewdney, on self-instruction in elementary arithmetic. The committee invites teachers conducting experiments in education to communicate with the secretary, 24 Royal Avenue, Chelsea, S.W.3.

AT the meeting of the London County Council Education Committee on July 11 the applications of the governing bodies of the London polytechnics for grants from the Council were considered. The committee decided to recommend that grants for the year 1917-18 only be made, as it was felt that in the circumstances of the present times it is impossible to forecast the position three years ahead. Eventually the following block grants for 1917-18 were decided upon: Battersea Polytechnic, 11,133*l.*; Birkbeck College, 7100*l.*; Borough Polytechnic, 9100*l.*; City of London College, 4040*l.*; Northampton Polytechnic, 4400*l.*; Northern Polytechnic, 9650*l.*; Regent Street Polytechnic, 14,300*l.*; Sir John Cass Technical Institute, 4000*l.*; South-Western Polytechnic, 7300*l.*; Woolwich Polytechnic, 9700*l.* A special grant of 1567*l.* was made to the governing body of Battersea Polytechnic for the establishment of a superannuation fund for the teachers in the secondary school.

WE have recently noticed with satisfaction the signs of an improved temper on the part of professed "humanists" with respect to the position to be accorded to natural and experimental science as an element in general education. The attention of our readers has been directed within the last few months to articles by writers so important as Mr. A. C. Benson and Lord Bryce. Now we have another even more sympathetic utterance from the Master of Balliol College, Oxford, who contributes to the *English Review* an expression of his views on "Natural Science in Education," beginning with the following words: "If there is one lesson more than another which the war is going to teach us, it will be the lesson as to the future place of natural science in our education." This is fairly obvious, and from one point of view almost a commonplace, for the majority of the public look to science merely for the sake of its practical application. It is not so much the invention of new flying machines or the discovery of new explosives that the world requires, but more exact knowledge in every direction. Science purifies common observation and teaches the nature and use of evidence. By science we learn something of the rules of the universe, and their control of the conditions under which human life exists. These rules cannot be ignored, and, as the writer remarks, "how powerless against them is even the best Parliamentary debating." Then there is the further and deeper influence which can only be justly expressed by the term "spiritual"—that effect of mingled awe and exultation which is produced when science opens out some profound vista of the universe. All the methods to be used in education require good teachers, and therein lies one of the difficulties of the time immediately ahead of us. The author touches on many of the questions concerning which debate is still going on, such as, for example, the already generally overloaded curriculum. While it is comforting to reflect that the best classical teachers admit that there has been a great deal of wasted drill in grammar and composition, it is the ignorance and apathy of the public which are to blame in having so long accepted without stronger remonstrance the purely bookish character of the system under which our boys and girls have been brought up.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 28.—Sir J. J. Thomson, president, in the chair.—Sir Robert **Hadfield**, Ch. **Chéneveau**, and Ch. **Géneau**: A contribution to the study of the magnetic properties of manganese and of some special manganese steels. (1) The research has had for its object the investigation of the mass-susceptibility of manganese metal, and of certain of its alloys with iron and other metals. The work was carried out on a Curie-Chéneveau magnetic balance. (2) Manganese itself, when free from occluded gases, is para-magnetic, its value of χ being $+11{\cdot}0\times10^{-6}\pm2$ per cent. This corresponds on Weiss's theory to a number of magnetons equal to 6. The removal of occluded gases is essential, as the ferro-magnetic properties of certain specimens of manganese are shown to be due to the presence of hydrogen. (3) The manganese alloys investigated, with one exception, are all para-magnetic, χ varying from $17{\cdot}0\times10^{-6}$ to $259{\cdot}0\times10^{-6}$. The exception mentioned is a silico-manganese steel containing 6 per cent. of silicon, which is distinctly ferro-magnetic. (4) An endeavour is also made to correlate the values of the mass-susceptibility with the composition of the alloys. In this connection it has been shown that the quantity of manganese within the limits investigated has very little influence upon the susceptibility, whilst increase of carbon tends to decrease it. In general it is concluded that in these special steels the susceptibility decreases as the carbon-manganese ratio increases. (5) The carbon-manganese ratio being constant, addition of chromium, nickel, or tungsten raises the susceptibility. (6) The addition of copper to a manganese-nickel steel also raises the susceptibility—this notwithstanding the diamagnetism of copper.—W. R. **Bousfield**: Note on the specific heat of water. Replying to criticisms by Callendar (Bakerian Lecture, Phil. Trans., A, 212, p. 1, 1912) on the methods for investigating the specific heat of water described in a former paper (W. R. Bousfield and W. Eric Bousfield, Phil. Trans., A, 211, p. 199, 1911), it is pointed out that the observations of Callendar do not substantially affect the question as to which figures are more correct in the lower range of temperature from 0° to 40° or 50° C. Callendar and Barnes differ from other observers in placing the minimum value for the specific heat of water in the neighbourhood of 40° C., whilst other observers put it at about 25° C.—W. R. **Bousfield** and C. Elspeth **Bousfield**: The specific heat of aqueous solutions with special reference to sodium and potassium chlorides. The specific heats of solutions of NaCl and KCl ranging from saturated solutions to quarter-normal solutions at mean temperatures of 7°, 20°, and 33° C. have been determined by the method and apparatus used for the determination of the specific heat of water and described in a former paper (Phil. Trans., A, 211, p. 199, 1911). The corresponding densities have also been determined. The relation of the specific heat of the solution to the specific contraction of the water is studied, and it is shown that the specific heat of a series of solutions of different concentrations may be reckoned on the hypothesis that the specific heat of the solute is constant, whilst the mean specific heat lowering of the water is proportional to the specific contraction of the water. The temperature variations of the specific heats of the solutions are also compared with the temperature variations of the specific heat of water. The minimum value on the temperature-specific heat curve, which occurs at about 25° C. in the case of water, disappears altogether in solutions of half-normal to normal strength. This curve for the most concentrated solutions becomes a straight line.—

Sir George **Greenhill**: The Rankine trochoidal wave. The Rankine trochoidal wave (Phil. Trans., 1863), either as rollers or as a starting wave, can be divided up by vertical planes perpendicular to the wave crest into compartments, and the compartments sheared along each other. The investigation is made of the extra field of force in addition to gravity when the shear is made continuous and the planes removed in order that the continuity of pressure should be preserved in the interior of the water, and for the new wave motion to persist. Also when the planes stand over to the vertical and the circular orbits in the roller are in parallel planes. A geometrical investigation is added of the molecular rotation in the interior of the Rankine wave.—Dr. P. E. **Shaw**: The tribo-electric series. (1) The tribo-electric series, in which solid materials are arranged in order according to the charge they acquire when rubbed together, is trustworthy with due precautions. (2) Most solids are found to alter their place in the series if heated above a certain temperature which is specific for each material. This temperature is called the critical temperature. The surface in its new condition is termed abnormal. (3) The series may be divided into an upper Group A and a lower Group B. It is found that these groups have tendencies contrary to one another as the surfaces of the materials are rendered (*a*) matte, or (*b*) abnormal, or (*c*) pressed, or (*d*) flexed. If under any of these agencies Group A becomes more + forming, Group B becomes more − forming, and *vice versa*. (4) Anomalous effects are observed when liquid mercury is used as one of the materials, its behaviour being quite unlike that of solid surfaces. (5) As to theory, it is suggested that the prevalent idea that the electric double-layer existing at the surface of solids has the − layer outermost in all cases is incorrect. Normally the materials in Group A would have − outermost, those in Group B having + outermost. Orientation of surface atoms would give rise to changes in the disposition of the two electric layers and so account for observed effects. (6) Tribo-electricity undoubtedly affords a means, of extraordinary delicacy, of discriminating between materials apparently alike. Two instances are seen in the group of furs and the group of woods.—J. J. **Nolan**: The nature of the ions produced by the spraying of water. Part i. gives an account of the determination of the mobilities of the very mobile ions produced by the spraying of water. Groups of ions are found, positive and negative, some of very high mobility. In part ii. the less mobile ions described in a previous paper are discussed. Treating the ions as minute spheres of water, it is shown that their sizes as deduced from an empirical modification of Stokes's law would agree with the sizes calculated from the ordinary theoretical mobility formulæ. Certain evidence, however, tends to show that the larger of these ions are not simple spheres of water, but that they consist of loose groupings of various numbers of some smaller water-globules. In part iii. it is shown that the very mobile ions can be accounted for by supposing that they consist of aggregates of various numbers of water-molecules, the numbers of molecules in the various ions being related to one another in a regular way. Some of these ions have the same mobility as ions produced in air by X-rays, etc. It is suggested that the ordinary gaseous ion consists of a group of water-molecules, the size of the group depending on the degree of moisture of the gas.—Prof. J. C. **McLennan**: The absorption spectra and the ionisation potentials of calcium, strontium, and barium.—J. **Small**: Geotropism and the Weber-Fechner law.—Prof. W. B. **Bottomley**: The isolation from peat of certain nucleic acid derivatives.

BOOKS RECEIVED.

Spiritualism and Sir Oliver Lodge. By Dr. C. A. Mercier. Pp. xi+132. (London: Mental Culture Enterprise.) 4*s*. 6*d*. net.

A Manual of Field Astronomy. By A. H. Holt. Pp. x+128. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Laboratory Manual of Bituminous Materials for the Use of Students in Highway Engineering. By Prévost Hubbard. Pp. xi+153. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

The Fundus Oculi of Birds, especially as Viewed by the Ophthalmoscope. By Casey Albert Wood. Pp. 180+plates lxi. (Chicago: The Lakeside Press.)

Fifty-fifth Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan and Twenty-ninth Annual Report of the Experiment Station from June 1, 1915–June 30, 1916. Pp. 896. (Lansing, Mich.: Wynkoop Hallenbeck Crawford Co.)

Critique des Propulseurs. Par Paul Popovatz. Pp. 131. (Paris: Gauthier-Villars et Cie.)

Science and Industry. The Place of Cambridge in any Scheme for their Combination. The Rede Lecture, 1917. By Sir R. T. Glazebrook. Pp. 51. (Cambridge: At the University Press.) 1*s*. 6*d*. net.

The National University of Ireland. Calendar for the Year 1917. Pp. viii+579. (Dublin: A. Thom and Co., Ltd.)

The Biology of Waterworks. By R. Kirkpatrick. (Economic Series, No. 7.) Pp. vi+58. (London: British Museum, Natural History.)

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THURSDAY, JULY 26, 1917.

AFTER THE WAR.

The War and the Nation: A Study in Constructive Politics. By W. C. D. Whetham. Pp. viii+312. (London: John Murray, 1917.) Price 6*s*. net.

IN a very readable and interesting little book of about three hundred pages Mr. Dampier Whetham has made a contribution of considerable value to the literature called forth by the present world-shaking war. With clear insight and breadth of information he deals with the new conditions of life which have been created for the Empire, the nation, and the citizen by the gigantic Teuton conspiracy to grasp world-empire for the Hohenzollern dynasty and the crowd of adventurers and militarists by whom it is supported. The defeat of this nefarious project has cost and will still cost the great liberty-loving democracies of the world incalculable sacrifices in life and treasure. All that is most precious in human life is, however, at stake, and hence the work of crushing Prussian militarism must be done now, and done so effectively that it will never raise its brutal dragon-head again.

The main topic of Mr. Whetham's book is the consideration of the steps which will have to be taken to make good the inevitable losses, and to support that load of national debt which will have been incurred. The book is divided into six chapters, respectively entitled *Laissez-faire* or constructive politics; The land and they that dwell thereon; The organisation of British industry and commerce; Coal and railways; The war and the race; Finance and taxation. It will be seen that the topics handled lie as much within the realm of political economy as within that of scientific or technical work, and much has already been said or written by scientific men and industrial leaders on some of the matters discussed.

One of the most important questions is the serious loss to the nation of young, highly trained, capable, and promising men who have given their lives for the salvation of their country. Mr. Whetham remarks that one point in favour of conscription for military service is that a certain equality of sacrifice is thereby demanded from the whole nation. In the case of voluntary service it is the most public-spirited, high-minded, vigorous, and able men who proffer first and take the greatest risks, and give in consequence life or limbs. Hence such voluntary service tends to deplete the ranks of those of the nation who have most leading power or initiative, and tends to the survival of the physically weak, timid, or reluctant.

Be that as it may, we have to face the fact that there has been an appalling loss of young men of great abilities, whose training and talents are now lost to the world and whose place must be taken by still younger or older men. The immediate consequence of this is that much more scientific care must be taken to preserve child life and promote physical vigour, and to combat diseases, especially of the contagious types, affecting children, which is a matter chiefly for scientific research.

Again, Mr. Whetham touches on the utterly unscientific administration of direct taxation. By taxing the joint income of husband and wife, by insufficient allowance for families, by death duties on the careful savings of income, and in other ways, the State penalises marriage, thrift, and reproduction. Furthermore, we have to bring about with expedition the reforms in education for which scientific students of the subject have been clamouring for years, and get rid of antiquated methods in infant, board, secondary, and public schools. Happily, we have now a President of the Board of Education who means business, and is not a politician.

The second key fact is the stupendous increase in the National Debt. Mr. Whetham shows that we shall be lucky if we end the war with not more than 5,000,000,000*l*. sterling of debt and 500,000,000*l*. for our annual Budget. How is this to be obtained and liquefied? The answer is: Solely by more work, more intelligent work, and greater economy and saving of all kinds. This leads Mr. Whetham at once to discuss the coal question, which has already attracted great attention. The world's coal supply is large, but not unlimited. It is estimated at seven to nine billion tons. The available British share is 189,000 million tons, according to the estimates of the International Geological Congress held in 1913, and Prof. H. S. Jevons thinks that in fifty years the price of British coal will be rising distinctly relatively to other commodities. Hence we can afford no waste. The consumption of raw coal in household grates ought soon to be interdicted, as well as open coke ovens, which waste the by-products. Mr. Whetham discusses the question of the nationalisation of coal mines, as well as that of railways, chiefly from the point of view of economy of management and working.

An important section of the book is chap. iii., on the organisation of British commerce and industry and its relation to scientific research. There can be no question that we shall not be able to return again to the old *laissez-faire* methods and to small disconnected businesses rivalling each other and all being defeated by German organised trade and science. The war has done more to kill these antiquated methods than a century of talk would have accomplished. The chief cloud on the horizon is, however, the relation of capital and labour. An extensive adoption of profit-sharing or co-partnership in some form or other seems the only solution. Labour must have its living wage and capital its interest, which will remain for decades now at 5 to 6 per cent. After that must come an equitable division of the profits between all concerned. Labour must, however, be brought to see that there are four factors concerned in production, viz. labour, capital, scientific invention or initiative, and business management, and that without the two latter the two former are helpless.

Altogether Mr. Whetham's book is a suggestive and very thoughtful contribution to the chief topic of the day, and it ought to be in the hands of those

statesmen and publicists who will have to draft workable schemes before very long to meet the demands and conditions of the strenuous life which lies before us all, even in those brighter days to come when the world will have shaken off the incubus of Prussianism with its accursed doctrine of brute force and bloodshed for the sake of German supremacy and *Kultur*.

J. A. FLEMING.

AMERICAN SYLVICULTURE.

Seeding and Planting: A Manual for the Guidance of Forestry Students, Foresters, Nurserymen, Forest Owners, and Farmers. By J. W. Toumey. Pp. xxxvi + 455. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 16*s*. 6*d*. net.

THIS is the best text-book on a forestry subject which has yet appeared in America. The author, now director of the Forest School in Yale University, was formerly in the U.S. Forest Service, where he was chiefly employed in the supervision of the nurseries and plantations in the national forests. He made also a study and personal inspection of the methods of nursery work and artificial regeneration of forests in Europe. This book purports by its title to deal with the operations of sowing and planting trees, but is wider in its scope, being a manual on afforestation in general. It is clearly written, and is distinguished by its discussion of fundamental principles, as well as by its comprehensive treatment of the details of nursery and planting practice. The usefulness of the book is enhanced by its remarkably good illustrations and diagrams. Though primarily intended for American foresters, it will be found equally useful in this country.

The introduction gives an account of the present condition of the forests in the United States, their economic importance, and the need for artificial regeneration. The original forest land of the United States, before the onslaught of European settlers, approximated to 850,000,000 acres in area. This vast heritage has gradually been reduced by fire, felling for timber, and clearing for farms to 550,000,000 acres. Of this, about 240,000,000 acres, comprising the most valuable tracts of timber, are owned by large companies. Some 200,000,000 acres are scattered over the whole country in countless small holdings, called wood-lots. These often resemble in size and quality the woodlands on private estates in England, and like them might be much benefited by better management and improved sylviculture. The publicly owned forests contain more than 100,000,000 acres of saleable timber, the greater part of which is in the West and in the national forests.

The national forests are 162 in number, with an extent of 163,000,000 acres; but this is not all timber land, as it includes much grazing and treeless tracts. The national forests were set aside out of the public lands which had not as yet been alienated to settlers. The rescue of so much of the original forest from the perils of private ownership is quite recent, and is perhaps the greatest feat of American statesmanship since the abolition of slavery. The first effective step was taken in 1891, when an Act was passed which gave the President the right to create "forest reserves," now styled "national forests," by proclamation. Since then this magnificent public domain has been created, mainly through the efforts of Gifford Pinchot, who became head of the Forest Service in 1898, and whose views were carried out on a grand scale by virile Presidents like Cleveland and Roosevelt.

The body of the work is divided into two parts. Part i. deals with general methods of reproduction, with the choice of species in artificial regeneration, and with the principles which determine the spacing of plants and the density of woods. Part ii. gives a detailed account of the quality, production, collection, and testing of seeds; the protection and preliminary treatment of nursery and planting areas; the management and cultivation of the forest nursery; and the establishment of woods by direct sowing and by planting.

Mr. Toumey's main note is economy; and he quotes (p. 425) the cost of planting in Pennsylvania, where 4,329,321 trees were planted by the State Forester in 1915, at the rate of 8.61 dollars, or 1*l*. 16*s*., per acre for stock and labour. With this may be compared an example of the cost of planting in England. The Manchester Corporation, paying labourers at 25*s*. a week, planted 97 acres in 1910 at Thirlmere, at an average cost, for stock and labour, of 4*l*. 16*s*. 6*d*. per acre (see Trans. R. Scott. Arboricult. Soc., xxvi., p. 42). The comparatively low cost for effective planting in the former case is due in part to wider spacing and consequent fewer plants, and to the use of smaller seedlings; but there still remains some balance to be put to the credit of greater efficiency of labour in Pennsylvania and better planting methods.

MANUALS OF CHEMISTRY.

(1) *Chemistry for Beginners and for Use in Primary and Public Schools.* By C. T. Kingzett. Pp. vi + 106. (London: Baillière, Tindall, and Cox, 1917.) Price 2*s*. 6*d*. net.

(2) *A Short System of Qualitative Analysis for Students of Inorganic Chemistry.* By Dr. R. M. Caven. Pp. viii + 162. (London: Blackie and Son, Ltd., 1917.) Price 2*s*.

(1) MR. KINGZETT'S little book is for beginners. He points out quite rightly that our "future commercial prosperity" depends upon the greater cultivation of science, and that we ought to "give all our boys the earliest opportunity of acquiring an elemental knowledge of such subjects." That science should form an essential part of everyone's education, as did formerly the three R's, is now generally admitted. The difficulty is as to the best method of instruction at the various stages of a child's development. The present writer must confess that, however excellent the matter and arrangement of this small volume may be, it is scarcely a book for the young scientific tyro. In the first

place, it is doubtful whether systematic chemistry, entirely divorced from elementary physics, is a useful introduction. It is further open to question whether the notion of atomic weights, chemical equations, and valency can be assimilated at this stage; yet these subjects are discussed within the first twenty pages. Finally, we submit that it is unnecessary and undesirable for a beginner to be introduced to more than a small fraction of the whole gamut of the elements and some of their chief compounds, even though they may find some application in the arts and manufactures. No doubt the book is intended to be associated with laboratory practice or some form of experimental demonstration, for there is not a single illustration representing chemical apparatus. For so small a volume, which is not much larger in dimensions than the "People's Books," the price of 2s. 6d. seems excessive.

(2) The chief novelty in Dr. Caven's little book on qualitative analysis is the arrangement. Instead of presenting the reactions for the individual metals in their group order, as is usually done, the author directs the student first to the study of the individual reagents, so that the basis of group classification may become evident at the outset. Thus the action of heat and other dry tests are taken first, and are followed by the action of solvents and, finally, by that of the group reagents. This forms Part i., while Part ii. is devoted to the usual description of reactions for the metals and acids, taken in group order. Part iii. contains a short summary of the process of analysis.

The author considers that this arrangement has proved more satisfactory in actual practice than the older scheme, and, moreover, regards it as more scientific. No doubt the first claim is well founded on its alleged success; the second merely turns on a choice between the inductive and the deductive method, but who shall say which is the more scientific? J. B. C.

OUR BOOKSHELF.

The Statesman's Year-Book, Statistical and Historical Annual of the States of the World for the Year 1917. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Fifty-fourth annual publication. Revised after official returns. Pp. xliv + 1504 + plates 4. (London: Macmillan and Co., Ltd., 1917.) Price 12s. 6d. net.

THE new edition of this valuable year-book has been slightly reduced in size without lessening its usefulness. Considerable difficulties have had to be faced in the revision of the statistics of belligerent, and especially enemy, countries, but these have been overcome in many cases. The value of the book is enhanced by the figures in most countries being given for at least the last pre-war year in addition to later years, where the latter were available. There are four maps, showing respectively: States engaged in the war up to May 10, 1917; Arabia, with political divisions; the railways of South America; and the canals and inland waterways of the United Kingdom. The additions and corrections contain material received too late to be embodied in the work, and include a section on Arabia. Accurate information about Russian railways is difficult enough to obtain in peace time, and the editors have been wise to give a list of lines "being built, approved for construction, or projected" without further discrimination. The Amur line, however, is now built, and we believe has been in use for a year or more. Among other useful matter in the introductory tables are the figures for the world's production of various metals, sugar, and grain. The list of the chief events of the war is brought up to May, 1917, and a further list of the chief books on the war is added.

Microscopic Analysis of Cattle-Foods. By T. N. Morris. Pp. viii + 74 – figs. 54. (Cambridge: At the University Press, 1917.) Price 2s. net.

IT is curious that whereas the chemical analysis of cattle-foods has given rise to a considerable array of text-books, the equally, or often more, important microscopic analysis has hitherto been neglected by the English writer apart from its treatment in the pages of Winton's standard treatise on vegetable foods in general.

The latter has been judiciously drawn upon in the compilation of the present work, which is put forward as "a brief guide in the recognition of the common legitimate constituents of cattle-foods," and makes no claim to be exhaustive. Within its few pages it gives an admirable summary of information on methods of examination and the chief histological characters of the common cereals, pulses, oil-seeds, cruciferous seeds, and nuts. The information is clear, concise, and accurate, and the accompanying diagrams are in many cases excellent. Very few of the common impurities of cattle-foods are omitted, the chief exceptions one notes being coffee husks, dari, gram, and sesame. A note might also have been included on the castor bean, which has frequently played a sinister part as an ingredient of oil-cakes, and in alleged non-toxic form is now seeking a place as a legitimate cattle feeding-stuff. No reference is made to animal matters, such as meat and fish refuse, which are now coming into increasing use on the farm. The book should prove very useful to the agricultural student, and within its limits also to the agricultural analyst.

Science and Industry: The Place of Cambridge in any Scheme for their Combination. By Sir Richard T. Glazebrook. Pp. 51. (Cambridge: At the University Press, 1917.) Price 1s. 6d. net.

READERS will be glad that the Rede lecture for this year, delivered by Sir Richard Glazebrook on June 9, is now available in book form. We were able to publish the greater part of the lecture in our issue for June 21 (vol. xcix., p. 333), and it will suffice here to say that we hope the essay will be widely studied, dealing as it does with matters of the highest importance which must be handled boldly if the future welfare of the nation is to be assured.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Visibility of Interference Fringes and the Double Slit.

THE writer has found the following simple arrangement well adapted for the study of the visibility of fringes arising from a double slit and a "source" slit of variable width. A double slit, ruled without any special care on a piece of old photographic negative, was placed on the table of a spectrometer after the usual adjustments had been made. With this arrangement and a sodium flame (Mecker burner) as the source of light, no difficulty was experienced in observing the disappearance and reappearance of the fringes, with gradually decreasing visibility, some seven times.

In the experiment as ordinarily performed (V. Mann's "Manual of Advanced Optics," p. 27) the source slit is at such a distance from the double slit as to render the experiment impracticable, or at least very inconvenient, in many laboratories. Ordinarily, too, a strong source of light is used, whereas the above arrangement permits the use of a monochromatic source. It provides, further, a very simple experiment by means of which the student beginning the study of advanced optics may obtain concrete ideas on the somewhat difficult subject of visibility. With a little practice, estimates of the visibility at successive stages may be made, and the corresponding visibility curve plotted.

To make quantitative measurements, a graduated wheel was attached to the slit of an ordinary Wilson spectrometer, and afterwards calibrated by the aid of a travelling microscope. By this means the width of the slit corresponding to the places of disappearance of the fringes or to any stage of visibility could be read off directly, and in a short time a complete set of measurements taken. The following readings will give an idea of the quantitative value of the experiment:—

Width of double slit (b) ... ... = 0·903 mm.
Focal length of lens of collimator (f) = 166 „
Mean value of increase in slit width (w) for successive orders of zero visibility ... ... = 0·107 „
From which $\lambda = \frac{bw}{f} = 0·000582$ mm.

The quantity w is accurate to about 1 per cent. A more accurately calibrated spectrometer slit than was at the disposal of the writer would permit doubtless of greater accuracy in the measurements.

J. K. ROBERTSON.
Queen's University, Kingston, Canada.

Relations between the Spectra of X-Rays.

KOSSEL has found the following relations between the frequencies of the X-ray spectra:—

$$L_\alpha = K_\beta - K_\alpha \quad . \; . \; . \; . \; . \quad (A)$$
$$M_\alpha = L_\gamma - L_\alpha \quad . \; . \; . \; . \; . \quad (B)$$

As the result of recent measurements, it is known that all these series consist of many more lines. According to T. Malmer the relation (A) of Kossel must take the form:—

$$L_{\alpha_1} = K_{\beta_1} - K_{\alpha_2} \quad . \; . \; . \; . \; . \quad (1)$$

Adopting the values for the wave-length given by M. Siegbahn (*Jahrb. d. Radioakt. u. Elektr.*), we have, moreover, instead of (B),

$$M_\beta = L_{\gamma_1} - L_{\beta_4} \quad . \; . \; . \; . \; . \quad (2)$$
$$M_{\gamma_1} = L_{\gamma_2} - L_{\beta_1} \quad . \; . \; . \; . \; . \quad (3)$$

I will here also remark that the following relations hold very exactly through all the elements:—

$$\left.\begin{aligned} L_{\alpha_2} - L_{\beta_2} &= L_{\beta_1} - L_{\gamma_1} \\ &= L_{\beta_3} - L_{\gamma_2} + \Delta \end{aligned}\right\} \quad . \; . \quad (4)$$

where Δ is a constant.

In order to account for these relations, especially (4), Bohr's theoretical formula should be modified as follows:—

$$\nu = \nu_0 \left\{ \frac{(N - C_1)^2}{(n_1 + \mu_1)^2} - \frac{(N - C_2)^2}{(n_2 + \mu_2)^2} \right\}$$

N being the atomic number, n_1 and n_2 certain integers. It should be supposed that $N - C_1$ and $N - C_2$ represent the numbers of electric quanta contained in the "effective" nucleus charge. The curve in Moseley's diagram shows further that μ_1 and μ_2 are not absolute constants, but vary gradually from element to element.

JUN ISHIWARA.
Physical Institute, Sendai, Japan, April, 1917.

METEOROLOGY AND AVIATION.

A RECENT lecture by Lord Montagu of Beaulieu to the Aeronautical Society has directed attention to the possibility after the war of conveying mails and passengers, and perhaps goods, from place to place by aeroplanes. In suitable weather such transit should present no difficulty save that of expense, provided that landing places can be found in such positions that the stages may not be too long, but it is obvious that the weather is, and must remain, a very important factor for many years to come.

Since the foundation of the Meteorological Office under Admiral Fitzroy a large part of its business has been the issuing of storm warnings at certain selected coast stations for the benefit of shipping; and there is no doubt that such warnings during the fifty years or so in which they have been issued have been of great use, and indeed are so still. But the gradual displacement of sails by steam and the increase of size, with the greater trustworthiness of the engines, have rendered vessels far less dependent upon the weather than they were in Admiral Fitzroy's time, and in these days it is seldom that any regular passenger boat fails to make its passage, though it may be more or less delayed by bad weather. The case is likely to be different with aeroplanes if they are to take the place of mail steamers, and a heavy responsibility will be thrown upon the Meteorological Office or upon whatever body undertakes to issue forecasts for their guidance.

The kinds of weather inimical to aviation are too much wind, low cloud, and fog, and of these fog is perhaps the worst, as it is also in the case of shipping. The ways in which wind affects an aeroplane are various. There is the difficulty of starting and landing, but the days on which this is serious are not numerous, even in a windy country like England. But still there are days when landing is unsafe, and it is the misfortune

with an aeroplane that it must in some way or other come to the earth as soon as its stock of petrol is exhausted. It cannot, like a ship outside a port with a dangerous bar, wait until conditions are more favourable; it must come down, whatever the risk. Once in the air, a steady wind has no effect upon the flying of an aeroplane, although it has a great effect upon the direction of the course. So much misapprehension exists on this point that it cannot be put too clearly. First, however, it must be stated frankly that a perfectly steady wind does not exist in practice, but the ordinary wind becomes more and more steady as the height increases, and in so far as the drift of an aeroplane is concerned it has the same effect as a steady wind of the same mean velocity.

The pilot, therefore, if the earth is hidden from him by a sheet of clouds, is absolutely and entirely ignorant of the strength and direction of the wind in which he is flying; it is just the same to him if it be a dead calm or if it be blowing at the rate of a hundred miles an hour from the east or from the west; he is, indeed, as unconscious of the motion which he is sharing with the air as he is of his daily revolution at a rate in these latitudes of some 600 miles an hour round the axis of the earth. But the effect upon the drift of his machine may be very considerable, and as he does not know what it is he cannot allow for it. The sailor is also concerned with the drift of his vessel, but he has in general a fairly good knowledge of how much it is; the currents due to the tide can be predicted, and the leeway due to wind can be estimated, but it is not so with the airman. Moreover, the rate of drift of a vessel is mostly small in comparison with her motion through the water, but in exceptional instances the velocity of the wind may equal the velocity of the aeroplane.

Thus Glasgow lies very close to a point 400 miles due north of Plymouth, and an aeroplane leaving Plymouth and flying due north at eighty miles an hour would find itself close to Glasgow in five hours' time. Should, however, a strong west wind be blowing of which the pilot did not know, and also clouds so that he could not see the earth, he would, if steering by compass, find himself in five hours' time over the North Sea, and quite possibly much nearer to the Danish than to the English coast. In the present state of our knowledge he could obtain information at starting of the general direction and strength of the wind, but not in such detail that he could hit off Glasgow within 100 or 200 miles. If he could see the ground he could ascertain that he was not travelling in the way his machine was pointing, and would thus become aware of his drift, but if he could see the ground he could steer by the known landmarks. There would be few landmarks over the sea, but the appearance of the surface should give him information as to the strength of the wind, and also of its direction.

Hence it seems likely that in countries like England, where clouds prevail, long-distance flight, if it is to be carried on at regular times day after day, will have to be at low elevations. About 3000 ft. is the usual height of the winter cloud sheet, but it may on occasion easily descend to 2000 ft.

Wind, therefore, though when it is steady and in a favourable direction it may be of assistance for a journey in its own direction, will in general be a hindrance to aerial navigation, and when combined with low clouds may become an insuperable hindrance. In cases where its velocity and direction can be accurately foretold, the difficulty about allowing for the drift can be overcome, but such precise forecast is not yet practicable.

A gusty wind introduces difficulties of its own; the so-called holes in the air, of which one heard so much in the early days of aviation, were due to gustiness, but greater stability and speed in the machine are eliminating these difficulties.

Clouds introduce a difficulty of their own, apart from the point that has been already considered. It would seem at first sight as though a man would retain his sense of the vertical direction in any circumstances, but this is not so. Were a man placed inside a hollow vessel that was falling freely without air resistance, he would be entirely without sense of weight or direction, and the pilot of an aeroplane in an extensive mass of cloud is in much the same position. He cannot see any definite object, and apart from sight his sense of direction depends upon the reaction between him and the seat he is sitting on. So long as the motion is uniform this reaction is vertical, but any acceleration of the machine alters the direction and intensity of the reaction, and so confuses the sense of level. The same effect is produced upon a spirit-level or similar instrument, and so confusing is the effect that it is said the machine may almost be upside down without the pilot knowing it. It would seem as though a gyroscope might to some extent meet the difficulty. One result of this uncertainty of level is that astronomical observations for the determination of latitude and longitude are not possible unless the horizon can be seen, and thus the amount of the error produced by want of knowledge of the drift cannot be known.

Fog is to all intents and purposes simply a cloud touching the earth. Landing places for aviators have naturally been put in low, sheltered positions, partly because a shelter from wind is required, but probably chiefly because more or less of a dead level is necessary, and such flat places are more likely to be found at low altitudes. Such positions are especially liable to fog. The danger of a fog lies in its concealing the landing place and hiding from the pilot until the last moment his distance from the ground.

Thus it appears that the demand of the airman on the meteorologist is that he shall be able to forecast wind and fog, and, to a less extent, clouds, on the route the airman is proposing to follow. It has long been the business of the Meteorological Office to forecast wind, and a certain amount of precision has been attained. During last winter Major Taylor investigated the possibility of forecasting fog, and gave the results in lectures to the Royal Meteorological and Aeronautical Societies. His work constitutes

a considerable advance in the investigation of this difficult subject. If we express the wind in terms of its two components, W. to E. and S. to N., the probable error of a forecast for each component is perhaps about ten miles an hour, and there is not much prospect of improving this; the estimate is for England and the Continent, but further south the conditions are much better.

I do not wish to emphasise the difficulties which lie in the way of regular air services, but they are there, and the first step towards overcoming them is to admit their existence. W. H. DINES.

NORTH-EAST SIBERIA.[1]

THIS is a charming book of travel on a very interesting but seldom visited country—the far north-east of Siberia. One has to travel for a month from Verkhoyansk, "the pole of cold," situated on the Upper Yana River, to reach Sredne-Kolymsk, "the queen of the country, consisting of twenty or thirty little flat-roofed log-huts scattered about on the left bank of the Kolyma." In this "town" the author was interned, by the Ministry of the Interior, in company with a dozen comrade students involved in "political disorders," and he stayed there four years.

That was thirty years ago; but nothing has changed since. The post reaches this miserable hamlet only once every four months. For three or four months, before the Kolyma breaks its ice at the end of May, and fishing can be resumed in June, the population lives in a state of semi-starvation. "By the end of March all the store of fish is consumed, and the inhabitants begin to eat the food usually given to dogs, such as fish-bones, entrails, and half-decayed fish." The last three or four months, before a fresh supply of provisions is brought by the boats coming from the south, most of the inhabitants have no salt and no flour, and are compelled to eat the fish raw, because cooked fish without salt seems to be most unpalatable. Under these conditions the physical and mental deterioration of the population is, of course, unavoidable.

In this spot the author remained four years,

Chukchees. From "In Far North-East Siberia."

and he devotes interesting pages to a good-natured description of how the little community of student-exiles constructed for themselves unburned-brick stoves (instead of the usual Yakute open hearth in the midst of the hut), and made their own provisions of fish and frozen cream for the winter, as well as candles from reindeer-fat for the long arctic night; all this work being done "amidst interminable metaphysical discussions." These pages have all the freshness of youth.

Towards the end of his internment at Sredne-Kolymsk the author obtained permission to make a journey to Nijne-Kolymsk, at the mouth of the

[1] "In Far North-East Siberia." By I. W. Shklovsky ("Dioneo"). Translated by L. Edwards and Z. Shklovsky. Pp. vii+264. (London: Macmillan and Co., Ltd., 1916.) Price 8s. 6d. net.

Kolyma, and he was thus enabled to obtain a glimpse of the shores of the Arctic Ocean. He accomplished the 500-mile journey in twelve days, in a frail open boat, made of very thin wooden planks sewn together with twisted willow-strands, the holes being plugged with moss and the cracks filled with the gum of the larch. Having reached Nijne-Kolymsk at the time of the fishing, he stayed there part of the summer and the winter, so that he could visit the lonely spot of Sukharnoye, as also some Chukchee encampments.

The pages given to the description of the Yukaghirs and the Yakutes settled along the lower course of the Kolyma, especially to the Chukchees, as also the legend about the disappearance of the small tribe of the Kangenici, will be read with deep interest and sympathy. All the little scenes sketched by the author bear the stamp of truthfulness and artistic feeling.

P. KROPOTKIN.

WAR BREAD.

THE public has been led to feel some anxiety concerning the effects of the present war bread upon national health and efficiency. Suggestion plays an inevitable part in such a connection. Certain untoward symptoms in individuals, for which some other tangible cause is not immediately evident, are liable just now to be ascribed on the slenderest evidence to the bread eaten. Once the belief in a deleterious influence has arisen, it is easy to understand how widely it may spread by suggestion. In the opinion of those best qualified to know, there would seem to be little basis for any such condemnation of the bread. It rests, nevertheless, with the Food Controller to obtain the best possible evidence concerning the facts, and we are glad to know that Lord Rhondda and the Wheat Commissioners have empowered a committee of the Royal Society to make a full and thorough investigation. This committee comprises some eminent medical consultants, as well as the physiologists who have been serving on the main Food Committee of the society. Its task is to decide whether the higher extraction of the grain can in itself be held responsible for any disturbance of health, and whether the admixture of other cereals with the wheat has produced a less digestible loaf, owing, for instance, to the associated difficulties in milling and baking.

Among other matters which are also engaging the attention of the committee is a greater tendency to "rope" in the bread, alleged to be due to the higher extraction of the grain. The habits of *Bacillus mesentericus*, which, in its various strains, is responsible for ropy bread, are already well known to bacteriologists, and, empirically at least, to all the better informed among practical bakers. There is no reason to doubt that with the increased knowledge now being acquired any outbreaks of rope will in the future be easily controlled. That the presence in the loaf of cereals other than wheat can be directly harmful is most unlikely. A favourable effect should indeed be seen in a somewhat improved balance in the protein supplied. Maize, it is true, is said to be badly tolerated by certain individuals, though such cases must be rare. It is also stated that the starch of maize is not fully gelatinised when it is cooked in admixture with wheat under conditions suitable for the production of an all-wheat loaf.

These and other points will doubtless receive the attention of the investigating committee. Its most important task, however, will be to decide, by a thorough sifting of the evidence, the more general question as to whether the war bread is, as a matter of fact, producing any ill effects at all upon the public health. The public will be glad to know that the Food Controller is in possession of the facts.

Meanwhile, since it is of the utmost importance to the nation that a full supply of bread shall be maintained, while the amount of wheat available is not sufficient for the purpose, we are glad to observe that the medical Press is urging the profession to see that the privilege of obtaining high-grade wheat flour for cases supposed to have suffered from the war bread is at any rate not abused.

NOTES.

MR. ALAN A. CAMPBELL SWINTON has been elected chairman of the council of the Royal Society of Arts for the ensuing year.

THE Asiatic Society of Bengal has awarded the Barclay memorial medal to Col. H. H. Godwin-Austen, for his work in biology. The medal is awarded every two years to the individual who during that period has made the most meritorious contribution to biology with special reference to India.

DR. J. B. CLELAND has been elected president of the Royal Society of New South Wales. After graduating in medicine, Dr. Cleland visited China and Japan, and later proceeded to this country, where he remained for several years, being for part of the time cancer research scholar at London Hospital. On returning to Australia, he was appointed Government pathologist and bacteriologist in Western Australia. In 1908 he became principal assistant microbiologist to the newly instituted Bureau of Microbiology in Sydney, and in 1913, on the amalgamation of the bureau with the Department of Public Health, he was appointed principal microbiologist. He has also been associated with the experimental work of the Department of Agriculture.

REFERRING to Dr. Collinge's recent article on "The Destruction of House-sparrows" (NATURE, June 28, p. 347), Dr. W. A. Hollis writes to say that the assumption that the corn found in the stomachs of the adult birds has been taken from the fields is, he believes, an erroneous one, and that in nine cases out of ten it is obtained from horse-droppings, as the house-sparrow rarely, if ever, goes far afield. At first sight this might appear so, but Dr. Hollis has overlooked the fact that the material upon which Dr. Collinge bases his argument was purposely obtained from agricultural districts, and in his account of the stomach contents of those birds obtained from suburban districts it is stated that the wheat was obtained "most likely from horse-droppings." The

house-sparrow is, unfortunately, very far from scarce in agricultural districts, and at present immense flocks from the towns and villages are adding to its number, the majority of which will remain until well into September.

WE regret to see the announcement of the death on July 22, at sixty-one years of age, of Mr. Alfred Mosely, C.M.G., whose work for industrial and educational efficiency is widely known. In the year 1903 Mr. Mosely organised an Educational Commission of leading representatives of science and education, including such men as Profs. Armstrong, Ayrton, and Ripper, to visit the United States. The twenty-six separate reports published in 1904 in the volume on this Educational Commission covered the whole field of education, from the kindergarten to post-graduate university work, and they provided the public with a very valuable statement by competent observers of the provision made for progressive education in America. In 1907 Mr. Mosely sent several hundred English school teachers to America to study the educational methods adopted in the United States and Canada, and himself about the same time made prolonged tours in those countries, during one of which he arranged for a return visit of 1000 school teachers to this country in 1908–9. Mr. Mosely was the author of a number of pamphlets and reports on industrial and educational matters and economics.

ACCORDING to a paragraph in *L'Economista d'Italia* of July 13, the Italian Royal Geological Commission has just presented the report of its work to the Government. The Commission recommends that immediate steps be taken to enable the Reale Ufficio Geologico to accelerate the preparation and publication of the geological map of Italy, which is a vital necessity in view of a recrudescence of activity being manifested in mineral prospecting and hydro-electric developments. Recommendations have also been made for the publication of the results of artesian well and mineral surveys which have been carried out in the country, since much importance is attached at present to a knowledge of the hydrological and geological data. It is also considered desirable that the collection of samples of Italian fossil-fuels at the Royal Geological Museum should be made as complete as possible, and that the authorities should proceed at once to publish the sheets (now completed) of the geological map which concern the mountainous regions, in view of the attention now being paid to the more extensive utilisation of Italy's water resources for power-raising.

THE *Indian Forester* for May contains an article on the organisation of the Chinese Forest Service, which came into existence in January, 1916, as a subordinate branch of the Ministry of Agriculture and Commerce at Peking. The heads of the service, styled "co-directors," are Mr. Forsythe Sherfesee, for six years employed in, and lately director of, the Philippine Forestry Bureau, and Mr. Ngan Han, who studied forestry in Cornell and Michigan Universities several years ago. There are other Chinese in the service, who have received a technical training in the United States, and an expert from Kew, Mr. W. Purdom, acts as botanist, and is chief of one of the six divisions into which the service is organised. In this article an ambitious programme of afforestation, education, propaganda, etc., is sketched out, but no details are given of any work that has been actually accomplished. The amount of funds available is not mentioned, and no information is given as to how the existing forests are to be brought under Government control, or of how land is to be acquired for afforestation. In the course of two or three years we may learn in what directions forestry can be developed in China.

IN his presidential address to the conference of delegates of the British Association, held at Burlington House on July 5, Mr. John Hopkinson dealt with the work and aims of the corresponding societies. Mr. Hopkinson first suggested, nearly forty years ago, that delegates from the different societies should hold an annual conference at the British Association meetings, and it must have been some satisfaction to him to preside over what is now an important annual event for many of the representatives of the scientific societies in this country. He gave a review of the work of the British Association as affecting the corresponding societies, dealing in turn with the various sections of the association. His address was so varied in its scope that each member of his audience must have felt that some of it at least had particular reference to his or her special study. It was not the address of a specialist, but on general lines, as might have been expected from a naturalist who has been so long the secretary of an important provincial society. Among the subjects dealt with were meteorology, geological photographs, bird protection, Desmids and Diatoms, maps, free trade, Kent's Cavern, the teaching of Greek, museums, and forestry. Mr. Hopkinson concluded that the chief aim of all of us should be

To make the world within his reach,
Somewhat the better for his being,
And gladder for his human speech.

PROF. J. H. BARNES, whose death was announced in NATURE of July 5, was educated at Five Ways Grammar School and the Birmingham University. After obtaining his degree, he spent some time in research work under Prof. Frankland, and in 1906 was appointed agricultural chemist to the Punjab and in charge of the Lyallpur College, one of the new agricultural colleges of India, of which two years later he was appointed principal, and which post he held until a few months before his death, when he was appointed chief chemist at the Pusa Institute to the Government of India. He was responsible for a considerable amount of agricultural research work, some of which is destined to make a great addition to the resources of the country, notably in the cultivation of the sugar-cane and wheat-growing. During the last few years he had been responsible for the experiments dealing with the reclamation of the alkali barren lands, which he had shown by his experiments to produce even record crops of wheat for India, and may revolutionise agriculture in certain of these districts. At the same time, he instituted a series of experiments showing the means of preventing various insect pests which are the great drawback to the methods of storing wheat. For his work on the Indigo Commission he was accorded the thanks of the Government of India. All this was carried out under great personal disabilities, for early in his official life he was attacked by malarial fever, from which periodically he suffered severely, especially during the last year or so of his life, which was eventually cut off by an attack of enteric fever on June 2. He was greatly loved and respected by all, especially by his Indian students, who at the time of his leaving the Lyallpur College collected funds to institute a scholarship at the college as a permanent memorial of his service there.

WITH Dr. C. O. Trechmann, who died on June 29, at his residence, Hudworth Tower, Castle Eden, passed away one of the small band of private collectors of minerals and one of the still smaller brotherhood of crystallographers in this country. He was born at Hartlepool, co. Durham, in 1851. His father, who

was a Dane by birth, settled in the north of England in 1843, and five years later, in 1848, founded the Portland cement works now known as Otto Trechmann, Ltd., at West Hartlepool, which are among the oldest works of the kind in the kingdom. Dr. Trechmann studied chemistry under Bunsen, and obtained his doctorate of philosophy at Heidelberg. On returning home he entered his father's business, and it was largely to his energy and ability that the development and prosperity of the works were due; on the conversion of the business into a limited liability company, he became chairman and managing director, a position he held until his death. While at Heidelberg he became interested in minerals, and started the formation of the collection which constituted the principal hobby of his life. Being a crystallographer, he had a keen eye for a well-crystallised specimen, and at his death the collection had grown to a considerable size and comprised specimens of much scientific value. At one period he was attracted by the minerals occurring in the famous quarry just off the valley of the Binn, and one of the sulpharsenites of silver found there was named trechmannite after him by its discoverer, Mr. R. H. Solly. He bequeathed some of the best specimens in his collection to the British Museum. Despite the calls of business, he contrived to find time to engage in crystallographical research, and published many papers, several of them dealing with the minerals found at Binn; his work was characterised by careful observation and skilful draughtsmanship. In later years he turned to entomology as a recreation, paying especial attention to exotic Rhopalocera and to Diptera, of which he made a local collection of considerable scientific value.

MR. HENRY BALFOUR discusses, in the July issue of *Man*, certain primitive forms of agricultural implements from the Naga Hills, Assam. A remarkable form used by the Sema, Lhota, and some eastern Nagas consists of a slip of bamboo, with a sharp edge, twisted into a shape like a necktie, which is used for eradicating weeds from crops. This has the disadvantage of being very perishable and, becoming supplanted by iron-bladed hoes, shows signs of obsolescence. But it is noteworthy that the original type of the bamboo weeder has been reproduced in iron. Thus, as the final result, we have four types: first, the bamboo "necktie" hoe; secondly, the copy of it in iron; thirdly, a two-tanged blade, hafted to two wooden rods, forming prolongations of the tangs, the ends of which are crossed, and so retain the "necktie" shape of the prototype; and, lastly, the same type of blade, hafted to a **Y**-shaped handle cut from a single piece, in which the single grip replaces the awkward **X**-shaped handle, the result being an eminently serviceable tool. The series is an admirable instance of clearly marked stages in the evolution of agricultural implements.

PROF. FLINDERS PETRIE notices a series of photographs from Abu Simbel depicting various racial types in *Ancient Egypt* (part ii., 1917). One of the most interesting represents a man with a long retreating forehead running up to a peak to the back of the head, with rolls of flesh on the back of the neck below the occiput. The same form of head is characteristic of the Armenians of to-day, though accompanied by a larger nose, and the Egyptian example seems to belong to a nation east of Asia Minor, somewhere about the head-waters of the Euphrates. Another, classed as North Arabian, has traces of an earring, which is an Assyrian characteristic, and this man may come from a region not greatly geographically separated from that of the first example. The Hittite type is marked by the thickness of hair ending in a curl below the shoulder. Another specimen, wearing a long cap with a sort of hanging tassel, is shown by the analogy of a type represented on the gates of Balawat to be that of a Phœnician boatman. Thus, of the ten examples, two seem to come from Armenia or its neighbourhood, and the others belong roughly to North and South Galilee.

THE expedition which Dr. Hamilton Rice led to the Amazon returned to New York this spring. From the *Geographical Review* for June (vol. iii., No. 6) we learn that after an ascent of the Amazon to Iquitos, the expedition returned to Manaos to undertake the ascent of the Rio Negro, which was to be the principal work of the expedition. In a river steamer the expedition reached Santa Isabel, and thence in a steam launch successfully traversed the difficult stretch of river to São Gabriel. Further progress proved to be impossible on account of low water. An attempt was made to ascend the Padauiry, a left tributary of the Rio Negro, but an immense sandbank blocked the way. The expedition then descended to Manaos, and Dr. Rice decided to return to the United States on account of the war news and other circumstances.

IN the *Geographical Review* for June there are two articles which deal in a most instructive way with the Eastern theatre of war in Europe. The first is by Prof. de Martonne on the Carpathians. Attention is paid particularly to the physical features controlling human movements, and the article gives a clear presentment of the complicated relief of the region. There is a good coloured relief map, besides several diagrams. The second article, by Mr. D. W. Johnson, on the conquest of Rumania, describes the geographical features of the country, especially in relation to the campaign of 1916. The author shows how geographical conditions favoured a Rumanian invasion of Bulgaria through the Dobrudja, but political considerations overruled this plan and embarked Rumania on an invasion of the Transylvanian plain, a project which materially assisted the success of the German plan for the conquest of Rumania.

IN a paper published in the *Scottish Geographical Magazine* for June (vol. xxxiii.) entitled "The Weddell Sea: An Historical Retrospect," Dr. W. S. Bruce has been at great pains to clear up the fog of obscurity which hitherto has enveloped the early history of exploration in that part of the Antarctic. With the exception of Mr. E. S. Balch's work on early American explorers, this paper is almost the first scholarly contribution to the history of the Antarctic, and, in view of the uncertainty that has prevailed regarding questions of priority in the Graham Land region and the trustworthiness of early accounts, this work was much needed. By persistence in following up clues Dr. Bruce has unearthed much previously overlooked material and several original log-books. The earliest explorers of the Weddell Sea were William Smith and Capt. Ed. Bransfield, R.N., in the brig *Williams*, early in 1820, subsequent to Smith's discovery of the South Shetlands in 1819. On this voyage they were the first to sight the mainland of the Antarctic continent, which Bransfield named Trinity Land. This point is of great interest, because it was previously held that the claim of the American sealer, N. B. Palmer, in 1821, has priority. As regards the discovery of the group known as the South Orkneys, Dr. Bruce recalls that priority belongs to Powell, who sighted them in December, 1821, and that Weddell six days later named them South Orkneys. Powell had regarded them merely as an extension of the South Shetlands, but they appear as Powell Group on the chart of 1822. Dr. Bruce,

however, recognises the undesirableness of changing the name of South Orkneys, which has now become established by long usage. Further interesting matter in this paper is an examination of the evidence of Morell, Ross, the *Scotia*, and others of land in the western part of the Weddell Sea. A critical examination of all this matter by a man who is familiar with polar conditions from personal experience sheds a new light on the question, and is most important in view of the forthcoming publication of Sir E. H. Shackleton's results. Finally, the full bibliography accompanying the paper should be noted.

THE Ministry of Trade of the Australian Commonwealth publishes "Further Investigations into the Etiology of Worm Nests in Cattle due to *Onchocerca Gibsoni*," by Drs. J. B. Cleland, S. Dodd, and E. W. Ferguson. Experiments have been tried as to the transmission of the larval worms by biting flies. As regards *Stomoxys calcitrans* the results are negative, but the authors consider that certain Tabanidæ may possibly act as carriers.

IN collaboration with Messrs. Harrison G. Dyar and F. Knal, Dr. Howard has completed the great monograph on the "Mosquitoes of North and Central America and the West Indies" (vol. iv., Carnegie Institution, Washington, 1917). The volume now issued contains the second part of the systematic description of genera and species, with appendix and index, and extends to more than 500 pages. Each genus and species is treated with an exhaustive synonymy, a full description of the imago and of any larval stages known, and in most cases with valuable bionomic details.

PROF. ULRIC DAHLGREN, of Princeton University, contributes a further instalment of his valuable series of essays on the "Production of Light by Animals" to the Journal of the Franklin Institute for July. In the present contribution he gives an able summary of what is known in regard to the production of phosphorescent light among the Tunicates and the fishes. In thus summarising the extensive and widely scattered literature on this theme Prof. Dahlgren has performed a very useful piece of work.

DR. G. A. BOULENGER contributes to the Annals of the South African Museum (vol. xii., part vi.) a long memoir on the genus Nucras, which, he convincingly shows, must be regarded as the most primitive of the Lacertidæ. He bases his conclusions partly on geological evidence and partly on a study of its geographical distribution and coloration. The latter aspect of this subject forms the material for two plates, which will well repay careful study. In the same issue he also describes a new South African lizard of the genus Eremias.

THE second of the series of reports which are to appear on the Australian Antarctic Expedition, 1911-14, has just been published. This is devoted to the Mollusca, forming part i. of vol. iv. The author, Mr. C. Hedley, analyses the results of dredgings at twelve stations on the coast of Adelie Land and of collections at Macquarrie Island. About one-third of the Mollusca prove to extend to Kerguelen, and some range round the Pole to the Falklands. More than 125 species are enumerated, of which forty-one are new to science. Two new genera are also described. Nine excellent plates add greatly to the value of this very able report.

WHILE the construction of great dams across natural streams for the purpose of diverting, or storing, their waters must inevitably disfigure the landscape in the immediate vicinity of the dams, this disfigurement may be amply atoned for by the creation of large lakes capable of vastly increasing the supply of food-fishes. Mr. A. D. Ferguson, of the California Fish and Game Commission, in *California Fish and Game*, vol. iii., No. 2, tells how this has been done in the case of impounding dams in the Sierra Nevada mountains. The building of the Crane Valley dam created the Bass Lake, a sheet of water six miles long, half a mile wide, and 100 ft. deep. This water is now teeming with trout and black bass, artificially introduced, affording a fishing resort for hundreds of people. Huntingdon Lake, in Fresno county, was similarly created by a dam 120 ft. high, impounding 150,000 acres of water. This has been stocked with rainbow and Loch Leven trout, and is the resort of thousands of people from all parts of the State. The primary purpose of the dam was to serve as a generating station for the Pacific Light and Power Corporation. In this way purely commercial ventures have been made to add both to the natural beauties of the country and to its productiveness.

THE plant ecology of the Drakensberg Range forms the subject of a beautifully illustrated paper by Prof. J. W. Bews, in vol. iii., part iii., of the Annals of the Natal Museum. In the opening pages the geological structure of the range is briefly described, and diagram sections of the horizontally placed beds are given. The striking feature of the range is the great mass of basalt and amygdaloidal lava which forms the main portion of the escarpment and produces the magnificent scenery of the Mont-aux-Sources. The vegetation of the higher parts of the Mont-aux-Sources has long been known to be peculiar, and it is a matter for regret that Prof. Bews does not give an account of it in greater detail. He distinguishes ten types of vegetation and gives lists of the plants characteristic for each. A number of the plants appear to be unidentified, which, considering the work recently done on South African botany, both at Kew and at the Cape, need not have been the case. On the mountain-tops the vegetation shows remarkable adaptations to dry conditions, the soil occurring only in depressions, the rest of the surface remaining bare rock.

PROF. R. B. YOUNG (Trans. Geol. Soc. South Africa, vol xix., p. 61) usefully develops F. Hinden's test for calcite in the presence of dolomite. After attacking the calcite on a thin section of rock with the solution of ferric chloride, thoroughly washing, and drying, a stream of sulphuretted hydrogen is turned on for a second or so, which blackens the calcite crystals.

MR. F. S. SPIERS, secretary of the Faraday Society, writes as follows:—"Will you permit me to correct a misapprehension which may arise out of a report in NATURE of July 12 (p. 393) on a joint meeting of the Society of Glass Technology with the Faraday Society which took place last month at Sheffield, to discuss the choice of refractory materials for use in the glass industry? In referring to an appeal which was made to glass-makers to make known their difficulties regarding refractories it was stated that the main object of the Faraday Society was to concentrate on these difficulties. This reference should have been, not to the Faraday Society, but to the Conference on Refractories Research, which has been constituted from all the interests concerned with refractory materials for the purpose of considering how best to co-ordinate and promote further the study of this subject."

AT the outbreak of war there was in this country a serious shortage of refractory material and of acid-proof apparatus such as is used in chemical works;

it had been largely stoneware imported from Germany. Fused silica ware has to some extent been able to make good the deficiency, and has helped to equip numerous factories erected in connection with the supply of explosives, especially as regards apparatus for the concentration of sulphuric acid and the condensation of nitric acid. Dr. F. Bottomley gives details of plants fitted with fused silica condensers, evaporators, etc., for these two acids, in the Journal of the Society of Chemical Industry for June 15, and also outlines the progress which has been made in the production of fused silica apparatus generally. Sixteen years ago small articles of silica were made by laboriously fusing quartz a few grains at a time in the oxyhydrogen blowpipe flame; at the present day the weight of fused material which can be worked exceeds 200 lb. The temperature required is between 1800° and 2000° C. In the plastic condition the silica is very ductile, and can be drawn out like glass in lengths of 90 to 100 ft.

TECHNOLOGIC PAPERS Nos. 83 and 84 of the U.S. Bureau of Standards represent continuations of Merica and Woodward's work on the "Failure of Brass" (No. 82). In the former an account is given of the study of the effect of tensile stress on the electrolytic solution potential of brass to various solutions, the results indicating an increase of E.M.F. of about 0·1 millivolt per 10,000 lb./sq. in. of stress. An explanation is given, based upon this effect, of the decreased ductility and strength exhibited by brass, where corroded while under tensile stress, and describes the growth of fissures in brass under such conditions. In the latter the results are recorded of an investigation of the initial stresses produced by the burning-in, without pre-heating, of constrained parts of castings of manganese bronze. Results have shown that, in general, tensile stresses will be produced within the burned-in area equal in value to the true elastic limit of the material. The conclusion is drawn that burning-in of such material should not be practised without thorough pre-heating or subsequent annealing of the whole casting.

THE *Biochemical Journal* for May contains a paper by Mr. H. E. Annett describing the isolation of raffinose from the seed of the jute plant (*Corchorus capsularis*). The sugar was identified by its content of water of crystallisation, specific rotatory power, and the change of the latter when the sugar was acted upon with emulsin, invertase, and melibiase. Further, the sugar does not give an osazone, but from the products of its hydrolysis with invertase, glucosazone and galactosazone were isolated. The sugar was isolated by extracting the finely ground jute seed, which had previously been exhausted with ether and petrol, with alcohol, and precipitating the alcoholic extract with ether. The particular sample of seed examined contained 2·25 per cent. of raffinose.

OF the chemical changes induced in amino-acids by bacterial action, the most common and the one that has been most studied is simple decarboxylation. It is by this process that putrescine and cadaverine are formed in the putrefaction of ornithine and lysine respectively. The deaminisation (*i.e.* loss of ammonia) of amino-acids by bacteria is usually accompanied by reduction, *e.g.* in the production of *p*-hydroxyphenyl-propionic acid from tyrosine. Mr. H. Raistrick, however, in the *Biochemical Journal* for May, describes the formation of an unsaturated carboxylic acid by the action of bacteria on histidine. This author avoided any possible secondary reactions by arranging that the histidine was the only organic substance present in the medium on which the bacteria were cultivated. When *B. coli communis*, *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *B. enteritidis*, Gaertner, or *B. dysenteriae*, Flexner, is grown on a medium consisting of Ringer's solution + histidine (β-iminazolyl-α-aminopropionic acid), from 5 to 60 per cent. of urocanic acid (β-iminazolylacrylic acid) is formed, the largest proportion with *B. paratyphosus* A, and the smallest with *B. typhosus*. The acid was identified by analysis, melting point, and preparation of the picrate and nitrate. This is the first instance on record of the bacteriological conversion of an amino-acid into an unsaturated acid.

MR. JOHN MURRAY'S list of announcements for the coming autumn contains several works which should be of interest to readers of NATURE, *e.g.* "The Life and Letters of Sir J. D. Hooker, O.M., G.C.S.I.," by Leonard Huxley, two vols.; "The Life of Sir Clements Markham, K.C.B., F.R.S.," by Admiral Sir A. H. Markham; "The Life of Sir Colin C. Scott Moncrieff," edited by Miss M. A. Hollings; "Rustic Sounds and other Studies in Literature and Natural History," by Sir Francis Darwin; "Volcanic Studies in Many Lands," by the late Dr. Tempest Anderson; second series, "Cotton and other Vegetable Fibres," by Dr. E. Goulding (Imperial Institute Handbooks), and a new and revised edition of "The Book of the Rothamsted Experiments," edited by Dr. E. J. Russell.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, Kingsway, have just issued a catalogue (New Series, No. 80) of books and papers on chemistry, pure and applied, mineralogy, mining, and geology. The list contains many works published in enemy countries and therefore difficult to obtain new at the present time; also the modern library of Mr. Andrea Angel, who lost his life in the East End explosion in January last. The catalogue will be sent free upon application.

OUR ASTRONOMICAL COLUMN.

METEORS ON JULY 19.—Though meteors were singularly rare in the two hours before midnight on July 19 they were rather abundant and brilliant after midnight. At 12h. 12m. G.M.T. one of magnitude 1 shot rapidly from $339°+72°$ to $261°+41°$, and left a bright streak. Its radiant was probably between α and β Persei. At 12h. 18m. a meteor exceeding magnitude 1 passed from $320°+35°$ to $317°+27°$, and was directed from Cepheus. At 12h. 37m. a very fine meteor with an extraordinarily long course of 89° travelled slowly from $328°+11°$ to $238°+10°$, and left a bright streak in its wake. At 13h. 35m. a blue, flashing meteor shot rapidly down across the star η Pegasi, and was directed from a shower near α Cygni or at $316°+48°$. At 13h. 50m. a tolerably bright meteor, leaving a streak, crossed the cluster in Perseus from a radiant at $40°+20°$, and at 14h. 15m. a bright Perseid, leaving a streak, shot from $326\frac{1}{2}°+17\frac{1}{2}°$ to $316°+6°$. Duplicate observations of any of these interesting objects, if sent to Mr. W. F. Denning (44 Egerton Road, Bristol) would enable their heights, etc., to be computed.

ANNUARIO OF THE RIO DE JANEIRO OBSERVATORY.—The thirty-third issue of this useful publication has recently been received. It contains numerous ephemerides and other astronomical data, together with an excellent collection of tables for the reduction of astronomical observations. A section is devoted to terrestrial physics, with special reference to the magnetic elements and the intensity of gravity, and another includes details of meteorological observations made at twenty-five stations in Brazil. Tide-tables for seven Brazilian ports, calculated with the aid of the Kelvin tide-predictor, are also included in the volume.

SOLAR PROMINENCES.—An important memoir on solar prominences has been published by Mr. and Mrs. Evershed (Memoirs Kodaikanal Obs., vol. i., part ii.). The total number of prominences observed and photographed at the sun's limb at Kenley and Kodaikanal during the years 1890 to 1914 was about 71,000, and in recent years the denser prominences have also been photographed as absorption markings on the sun's disc. This wealth of observational material is discussed from many points of view. It results, among other conclusions, that there are four belts, two in each hemisphere, which are specially prolific in prominences. The low-latitude belts are coincident with the sun-spot zones, and in these the prominences vary in number with the spots, although direct association of spots and prominences is comparatively rare. In the high-latitude belts the prominences are most frequent between spot minimum and spot maximum; they reach the pole about spot maximum, and die out there, to form again in latitude $\pm 50^{\circ}$. Magnetic storms appear to be more closely related to spots than to prominences, but it is possible that an overlying prominence is a necessary condition for a spot to produce a magnetic storm. Large high prominences are roughly divisible into four classes, namely, broad massive prominences, tapering forms, diffused forms, and prominences in rows. Prominences associated with spots take the form of jets, rockets, or arches. The prevailing rocket type suggests the action of an intermittent explosive force in spots, which only partially neutralises gravity, while in the large masses gravity appears to be completely neutralised by the upward force. The density of prominences is probably very low, and it is suggested that the luminosity may be due to the internal energy of the atoms, possibly derived mainly by absorption of the intense solar radiation. Numerous photographs of prominences are reproduced.

FUEL RESEARCH.

AT the request of the Board of Trade and other Government departments, the Fuel Research Board has undertaken an investigation on the most suitable composition and quality of gas, and the minimum pressure at which it should be supplied, having regard to the desirability for economy in the use of coal, the adequate recovery of by-products, and the purposes for which coal is now used. The Research Board will also act in an advisory capacity. With the great extension of the use of gas for power and heating, and the possibility of using efficiently for illuminating purposes, by means of the incandescent mantle, gas of much lower illuminating value than formerly, more importance now attaches to calorific value than to candle-power. Practice has necessarily conformed to the altered conditions, for gas engineers have gone a good way in solving the problems involved in making the best use of coal in their industry, in the recovery of by-products, on which success so much depends, together with supplying a gas satisfactory for the wide and varied requirements. The industry has indeed been exceptional in the valuable research work done, its enterprise being shown in the establishment of the Livesey Laboratory at Leeds.

Possibly the Research Board will find little scope for improvement in the general production of coal-gas, although no one would claim that finality has been reached, but some important problems remain for investigation, notably the production of low-temperature coke and the utilisation of the oils and very rich gas produced. The gas engineer has hitherto not regarded this question in an unprejudiced manner, whilst the advocates have generally been over-optimistic, so that independent investigation is really wanted. There is also a wide field for investigating how coke-oven gas may be more extensively employed to supplement the output of suitably situated gasworks, and the more extended use of water-gas.

The Fuel Research Board, with the sanction of the Committee of the Privy Council for Scientific and Industrial Research, has appointed a committee of inquiry into the utilisation of Irish peat deposits. The terms of reference to the committee are as follows:—"To inquire into and to consider the experience already gained in Ireland in respect of the winning, preparation, and use of peat for fuel and for other purposes, and to suggest what means shall be taken to ascertain the conditions under which, in the most favourably situated localities, it can be profitably won, prepared, and used, having regard to the economic conditions of Ireland; and to report to the Fuel Research Board."

Though the inquiries of the committee will ultimately lead up to the consideration of peat as a source of energy in central power stations, there are sound reasons why this aspect of the problem should be postponed to a later stage. On one hand, the Fuel Research Board is already organising an extensive inquiry into the problems of fuel economy in connection with power production, and the results of this inquiry will supply the fundamental data and information which will be required when the time comes for the consideration of any wide scheme of development in Ireland. On the other hand, any schemes of development must be based on a more exact knowledge than is at present available regarding the selection of the more favourably situated bogs and the possibilities of winning and transporting partially dried peat to centres at which it may be converted into marketable products. It is obvious, therefore, that the inquiries of the committee are likely to be most fruitful if they are concentrated on the fundamental problems, for until these are settled no satisfactory progress can be made.

The following appointments have been made to the committee:—Sir John Purser Griffith (chairman), Prof. Hugh Ryan, Prof. Sydney Young, Mr. George Fletcher, and Prof. Pierce Purcell (secretary). All communications should be addressed to the Secretary, The Peat Inquiry Committee, University College, Dublin.

GLASS TECHNOLOGY.

THE newly formed Society of Glass Technology is to be warmly congratulated on the first number of its Journal, which has just appeared. The volume contains five original papers and a considerable number of abstracts dealing with glass and allied subjects. These abstracts, in which an endeavour is made to summarise the literature of the subject—including that appearing on the Continent so far back as the beginning of 1915—form a most valuable feature, particularly as the difficult work of abstracting has been well done. If, at a later stage, the society could undertake to carry the abstracts back—if possible for a period of ten years—they would earn the gratitude of all concerned with glass. There is, of course, always the difficulty in such abstracts of discriminating between the wheat and the chaff, so as to avoid burdening the pages with abstracts of valueless material; such discrimination, however, demands a degree of intimate familiarity with the subject in both its industrial and scientific aspects which is scarcely obtainable in the case of glass, since this has only recently begun to receive in this country the attention which it deserves. It is, further, a little doubtful whether the editor of this Journal has been wise in including abstracts on purely optical subjects, since these are more

fully dealt with by a special society (the Optical Society), and overlapping is most undesirable in matters of publication.

The original papers attain a very creditable standard for so young a society and so new a subject. Prof. Boswell's work on British glass sands is already widely known and appreciated, since it has already been more or less completely published elsewhere. Mr. C. J. Peddle describes trials of British sands as substitutes for some of foreign origin, and his results are extremely hopeful, provided that careful treatment in regard to grading and washing is applied to the British materials. Mr. F. Twyman deals with the annealing of glass, and describes a method of testing the glass for strain and for its disappearance by means of a special form of polarimeter; the modification ascribed to Mr. F. E. Lamplough, however, is not novel, as the writer saw it in use more than fourteen years ago. Nor does Mr. Twyman make it quite clear that his reasoning is not applicable to any but thin glass vessels, such as the beakers he refers to. In such thin glassware all that is required is uniform cooling from the "annealing temperature" of Mr. Twyman; in thicker glass, however, such uniformity as between exterior and interior portions can be obtained only by very slow cooling.

Apart from detailed criticism of particular points, the whole volume clearly shows the vitality of the new society and the need for the co-ordinated study of glass and glass manufacture from the scientific point of view. It is to be hoped that all branches of the British glass industry, which has received a rejuvenating impulse from the war, will support the new society and thus facilitate the co-operation of science in an industry that should be essentially scientific.

PLANKTON RESEARCH AT PLYMOUTH.

THE May number of the Journal of the Marine Biological Association is devoted to an interesting account of the investigations of the plankton of the sea outside Plymouth Breakwater, made during the year September, 1915, to September, 1916. The main systematic research has been conducted by Miss Lebour, while Dr. Allen describes post-larval stages of fishes, and Mr. Matthews gives an account of the variation in the quantity of phosphoric acid present in the sea-water. Miss Lebour used Lohmann's method of centrifuging small volumes of sea-water (50 c.c.), and then actually counting the organisms so obtained. Her results are in general agreement with those of Lohmann (at Kiel) and Herdman and Scott (at Port Erin). There are well-marked seasons of abundance of microplanktonic organisms, diatoms occurring in greatest quantity some time in the spring or early summer, and then again in the autumn, while Peridiniales attain their maximum of seasonal abundance a little later than the diatoms. The Peridiniales have been very thoroughly investigated, and Miss Lebour describes eight species which are new to science and twenty-one species which have not hitherto been recorded from British seas. She also gives some records of the occurrence of larval Trematodes, free-swimming in the sea, and descriptions of the Helminth parasites of Sagitta. These worms have been noticed many times, and some of them are very familiar to planktologists, but no sound identifications have been made prior to the research now under notice. Sagitta is a host for larval forms of *Derogenes varicus* and *Pharyngora bacillaris*, both well-known fish Trematodes. A larval Ascaris also occurs, and two larval Cestodes, the species of which are not identifiable.

Mr. Matthews gives detailed accounts of his methods of determining the exceedingly small quantities of phosphoric acid which occur in sea-water, at the most about 0·06 mg. of P_2O_5 per litre. There is a well-marked maximum at nearly the end of the year (in the darkest days). The variations are dependent upon the metabolism of marine plants, and the minimum quantity of phosphoric acid occurs in April and May—that is, at about the time when holophytic plants are taking most food substance from the sea-water. The larger algæ seem to be the principal factors for the curve of variation in quantity of phosphoric acid not being the reverse of that for variation in abundance of diatoms, as was at first expected.

J. J.

CORRECTION FOR ATMOSPHERIC REFRACTION IN GEODETIC OPERATIONS.[1]

THE memoir before us is concerned with the correction for refraction in geodetic operations between distant stations, especially those differing considerably in altitude. The author quotes Helmert's elaborate formula, which gives the correction as a function of gravity, atmospheric pressure, coefficient of expansion of air, tension of aqueous vapour, temperature, and vertical temperature gradient. The values deduced from the formula are compared with those obtained by observation over several bases in Italy and the Alps. The results are grouped both by months and by hours of the day; they show in a clear manner that there are both diurnal and annual variations in the refraction coefficient, which appear to be mainly due to the changes in the vertical temperature gradient. The following table shows the results of two series, the coefficients in the first column being deduced from the formula, and in the second by experiment. The third column gives the observed vertical temperature gradient.

Months		Coefficient of refraction at noon		Diminution of temperature for 100 m. altitude in degrees Centigrade
		From formula	From experiment	
Jan., Dec.	...	0·175	—	0·44
Feb., Nov.	...	0·170	0·181	0·55
Mar., Oct.	..	0·158	0·168	0·68
Apr., Sept.	...	0·154	0·159	0·74
May, Aug.	...	0·145	0·154	0·79
June, July	...	0·144	0·153	0·79

The results of several measures of altitudes over long bases in Italy (length 23 km., difference of altitude 900 m.) show a range of somewhat over a metre, and indicate that better results are obtained by using the meteorological data of the lower station only than by combining those of both stations. The memoir closes with a table arranged to facilitate the application of the correction for temperature to measured altitudes in surveying.

A. C. D. CROMMELIN.

THE COMPLEXITY OF THE CHEMICAL ELEMENTS.[2]

II.

The Periodic Law and Radio-active Change.

THE second line of advance interprets the periodic law. It began in 1911 with the observation that the product of an α-ray change always occupied a place in the periodic table two places removed from the parent in the direction of diminishing mass, and that in subsequent changes where α rays are not expelled, the product frequently reverts in chemical character to

[1] "Sulla Determinazione del Coefficiente di Rifrazione Terrestre in Base ad Elementi Meteorologici." By Vincenzo Reina. (Roma: R. Accademia dei Lincei, ser. v., vol. xii., Fasc. ii., 1916.)

[2] Discourse delivered at the Royal Institution on Friday, May 18, by Prof. Frederick Soddy, F.R.S. Continued from p. 418.

that of the parent, though its atomic weight is reduced four units by the loss of the α particle, making the passage across the table curiously alternating. Thus the product of radium (Group II.) by an α-ray change is the emanation in the zero group, of ionium (Group IV.) radium, and so on, while in the thorium series thorium (Group IV.) produces by an α-ray change mesothorium-I (Group II.), which in subsequent changes in which no α rays are expelled yields radiothorium, back in Group IV. again ("Chemistry of the Radio-Elements," p. 29, first edition, 1911). Nothing at that time could be said about β-ray changes. The products were for the most part very short-lived and imperfectly characterised chemically, and several lacunæ still existed in the series, masking the simplicity of the process. But early in 1913 the whole scheme became clear, and was pointed out first by A. S. Russell, in a slightly imperfect form, independently by K. Fajans from electrochemical evidence, and by myself in full knowledge of Fleck's results, still for the most part unpublished, all within the same month of February. It was found that, making the assumption that uranium-X was in reality two successive products giving β rays, a prediction Fajans and Göhring proved to be correct within a month, and a slight alteration in the order at the beginning of the uranium series, every α-ray change produced a shift of place as described, and every β-ray change a shift of one place in the opposite direction. Further, and most significantly, when the successive members of the three disintegration series were put in the places in the table dictated by these two rules, it was found that all the elements occupying the same place were those which had been found to be non-separable by chemical processes from one another, and from the element already occupying that place, if it was occupied, before the discovery of radio-activity. For this reason the term isotope was coined to express an element chemically non-separable from the other, the term signifying "the same place."

So arranged, the three series extended from uranium to thallium, and the ultimate product of each series fell into the place occupied by the element lead. The ultimate products of thorium should, because six α particles are expelled in the process, have an atomic weight twenty-four units less than the parent, or about 208. The main ultimate product of uranium, since eight α particles are expelled in this case, should have the atomic weight 206. The atomic weight of ordinary lead is 207·2, which made it appear very likely that ordinary lead was a mixture of the two isotopes, derived from uranium and thorium. The prediction follows that lead, separated from a thorium mineral, should have an atomic weight about a unit higher, and that separated from uranium minerals about a unit lower, than the atomic weight of common lead, and in each case this has now been satisfactorily established.

The Atomic Weight of Lead from Radio-active Minerals.

It should be said that Boltwood and also Holmes had, from geological evidence, both decided definitely against its being possible that lead was a product of thorium, because thorium minerals contain too little lead, in proportion to the thorium, to accord with their geological ages; whereas the conclusion that lead was the ultimate product of the uranium series had been thoroughly established by geological evidence, and has been the means, in the hands of skilful investigators, of ascertaining geological ages with a degree of precision not hitherto possible. Fortunately I was not deterred by the *non possumus*, for it looks as if both conclusions are right! An explanation of this paradox will be attempted later. In point of fact, there are exceedingly few thorium minerals that do not contain uranium, and since the rate of change of uranium is about 2·6 times that of thorium, one part of uranium is equal as a lead producer to 2·6 parts of thorium. Thus Ceylon thorianite, one of the richest of thorium minerals, containing 60 to 70 per cent. of ThO_2, may contain 10 to 20, and even 30, per cent. of U_3O_8, and the lead from it may be expected to consist of very similar quantities of the two isotopes, to be, in fact, very similar to ordinary lead. I know of only one mineral which is suitable for this test. It was discovered at the same time as thorianite, and from the same locality, Ceylon thorite, a hydrated silicate containing some 57 per cent. of thorium and 1 per cent. of uranium only. In the original analysis no lead was recorded, but I found it contained 0·4 per cent., which, if it were derived from uranium only, would indicate a very hoary ancestry, comparable, indeed, with the period of average life of uranium itself. On the other hand, if all the lead (1) is of radio-active origin, (2) is stable, and (3) is derived from both constituents as the generalisation being discussed indicated, this 0·4 per cent. of lead should consist 95·5 per cent. of the thorium isotope and 4·5 per cent. of the uranium isotope. Thorite thus offered an extremely favourable case for examination.

In preliminary experiments in conjunction with H. Hyman, in which only a gram or less of the lead was available, the atomic weight was found relatively to ordinary lead to be perceptibly higher, and the difference, rather less than ½ per cent., was of the expected order.

I was so fortunate as to secure a lot of 30 kilos of this unique mineral, which was first carefully sorted piece by piece from admixed thorianite and doubtful specimens. From the 20 kilos of first-grade thorite the lead was separated, purified, reduced to metal, and cast *in vacuo* into a cylinder, and its density determined, together with that of a cylinder of common lead similarly purified and prepared. Sir Ernest Rutherford's theory of atomic structure, to be dealt with in the latter part of this discourse, and the whole of our knowledge as to what isotopes were, made it appear probable that their atomic volumes, like their chemical character and spectra, should be identical, and therefore that their density should be proportional to their atomic weight. The thorite lead proved to be 0·26 per cent. denser than the common lead. Taking the figure 207·2 for the atomic weight of common lead, the calculated atomic weight of the specimen should be 207·74.

The two specimens of lead were fractionally distilled *in vacuo*, and a comparison of the atomic weights of the two middle fractions made by a development of one of Stas's methods. The lead was converted into nitrate in a quartz vessel, and then into chloride by a current of hydrogen chloride, in which it was heated at gradually increasing temperature to constant weight. Only single determinations have been done, and they gave the values 207·20 for ordinary lead, and 207·694 for the thorite lead, figures that are in the ratio of 100 to 100·24. This therefore favoured the conclusion that the atomic volume of isotopes is constant.

At the request of Mr. Lawson, interned in Austria, and continuing his researches at the Radium Institut under Prof. Stefan Meyer, the first fraction of the distilled thorite lead was sent him, so that the work could be checked. He reports that Prof. Hönigschmid has carried through an atomic weight determination by the silver method, obtaining the value $207 \cdot 77 \pm 0 \cdot 014$ as the mean of eight determinations. Hence the conclusion that the atomic weight of lead derived from thorite is higher than that of common lead has been put beyond reasonable doubt.

Practically simultaneously with the first announce-

ment of these results for thorium lead, a series of investigations was published on the atomic weight of lead from uranium minerals by T. W. Richards and collaborators at Harvard, Maurice Curie in Paris, and Hönigschmid and collaborators in Vienna, which show that the atomic weight is lower than that of ordinary lead. The lowest result hitherto obtained is 206·046, by Hönigschmid and Mlle. Horovitz, for the lead from the very pure crystallised pitchblende from Morogoro (German East Africa), whilst Richards and Wadsworth obtained 206·085 for a carefully selected specimen of Norwegian cleveite. Numerous other results have been obtained, as, for example, 206·405 for lead from Joachimsthal pitchblende, 206·82 for lead from Ceylon thorianite, 207·08 for lead from monazite, the two latter being mixed uranium and thorium minerals. But the essential proportion between the two elements has not, unfortunately, been determined. Richards and Wadsworth have also examined the density of their uranium lead, and in every case they have been able to confirm the conclusion that the atomic volume of isotopes is constant, the uranium lead being as much lighter as its atomic weight is smaller than common lead. Many careful investigations of the spectra of these varieties of lead show that the spectrum is absolutely the same so far as can be seen.

Thorium and Ionium.

A second quite independent case of a difference in atomic weight between isotopes has been established. It concerns the isotopes thorium and ionium, and it is connected in an important way with the researches of which, on two previous occasions, I have given an account here, the researches on the growth of radium from uranium which have been in progress now for fourteen years. It is the intervention of ionium with its very long period of life which has made the experimental proof of the production of radium from uranium such a long piece of work. Previously only negative results were available. One could only say from the smallness of the expected growth of radium that the period of average life of ionium must be at least 100,000 years, forty times longer than that of radium, and, therefore, that there must be at least forty times as much ionium by weight as radium in uranium minerals, or at least 13·6 grams per 1000 kilos of uranium. Since then further measurements carried out by Miss Hitchins last year have shown definitely for the first time a clear growth of radium from uranium in the largest preparation, containing 3 kilos of uranium, and this growth, as theory requires, is proceeding according to the square of the time. In three years it amounted to 2×10^{-11} grams of radium, and in six years to just four times this quantity. From this result it was concluded that the previous estimate of 100,000 years for the period of ionium, though still of the nature of a minimum rather than a maximum, was very near to the actual period.

Joachimsthal pitchblende, the Austrian source of radium, contains only an infinitesimal proportion of thorium. An ionium preparation, separated by Auer von Welsbach from 30 tons of this mineral, since no thorium was added during the process, was an extremely concentrated ionium preparation. The atomic weight of ionium—calculated by adding to the atomic weight of its product, radium, four for the α particle expelled in the change—is 230, whereas that of thorium, its isotope, is slightly above 232. The question was whether the ionium-thorium preparation would contain enough ionium to show the difference. Hönigschmid and Mlle. Horovitz have made a special examination of the point, first re-determining as accurately as possible the atomic weight of thorium, and then that of the thorium-ionium preparation from pitchblende. They found 232·12 for the atomic weight of thorium, and by the same method 231·51 for that of the ionium-thorium. A very careful and complete examination of the spectra of the two materials showed for both absolutely the same spectrum and a complete absence of impurities.

If the atomic weight of ionium is 230, the ionium-thorium preparation must, from its atomic weight, contain 30 per cent. of ionium and 70 per cent. of thorium by weight. Prof. Meyer has made a comparison of the number of α particles given per second by this preparation with that given by pure radium, and found it to be in the ratio of 1 to 200. If 30 per cent. is ionium, the activity of pure ionium would be one-sixtieth of that of pure radium, and its period some sixty times greater, or 150,000 years. This confirms in a very satisfactory manner our direct estimate of 100,000 years as a minimum, and incidentally raises rather an interesting question.

My direct estimate involves directly the period of uranium itself, and if the value accepted for this is too high, that for the ionium will be correspondingly too low. Now, on May 11 Prof. Joly was bringing before you, I believe, some of his exceedingly interesting work on pleochroic halos, from which he has grounds for the conclusion that the accepted period of uranium may be too long.

But since I obtained, for the period of ionium, a minimum value two-thirds of that estimated by Meyer from the atomic weight, it is difficult to believe that the accepted period of uranium can have been over-estimated by more than 50 per cent. of the real period. The matter could be pushed to a further conclusion if it were found possible to estimate the percentage of thorium in the thorium-ionium preparation, a piece of work that ought not to be beyond the resources of radio-chemical analysis. This would then constitute a check on the period of uranium as well as on that of ionium. Such a direct check would be of considerable importance in the determination of geological ages.

The period of ionium enables us to calculate the ratio between the weights of ionium and uranium in pitchblende as 17·4 to 10^{6}, and the doctrine of the non-separability of isotopes leads directly to the ratio between the thorium and uranium in the mineral as 41·7 to 10^{6}. This quantity of thorium is unfortunately too small for direct estimation. Otherwise it would be possible to devise a very strict test of the degree of non-separability. As it is, the work is sufficiently convincing. Thirty tons of a mineral containing a majority of the known elements in detectable amount, in the hands of one whose researches in the most difficult field of chemical separation are world-renowned, yield a preparation of the order of one-millionth of the weight of the mineral, which cannot be distinguished from pure thorium in its chemical character. Anyone could tell in the dark that it was not pure thorium, for its α activity is 30,000 times greater than that of thorium. This is then submitted to that particular series of purifications designed to give the purest possible thorium for an atomic weight determination, and it emerges without any separation of the ionium, but with a spectrum identical with that of a control specimen of thorium similarly purified. The complete absence of impurities in the spectrum shows that the chemical work has been very effectively done, and the atomic weight shows that it must contain 30 per cent. by weight of the isotope ionium, a result which agrees with its α activity and the now known period of the latter.

Determination of Atomic Weights.

The results enumerated thus prove that the atomic weight can no longer be regarded as a natural constant, or the chemically pure element as a homogeneous type of matter. The latter may be, and doubtless often is, a mixture of isotopes varying in atomic weight over a small number of units, and the former then has no exact physical significance, being a mean value in which the proportions of the mixture as well as the separate atomic weights are both unknown. New ideals emerge and old ones are resuscitated by this development. There may be, after all, a very simple numerical relation between the true atomic weights. The view that seems most probably true at present is that while hydrogen and helium may be the ultimate constituents of matter in the Proutian sense, and the atomic weights therefore approximate multiples of that of hydrogen, small deviations, such as exist between the atomic weights of these two constituent elements themselves, may be due to the manner in which the atom is constituted, in accordance with the principle of mutual electromagnetic mass, developed by Silberstein and others. The electromagnetic mass of two charges in juxtaposition would not be the exact sum of the masses when the charges are separated. The atomic weight of hydrogen is 1·0078 in terms of that of helium as 3·99, and that the latter is not exactly four times the former may be the expression of this effect. Harkins and Wilson have recently gone into the question with some thoroughness, and the conclusion of most interest in the present connection which appears to emerge is in favour of regarding most of the effect to occur in the formation of helium from hydrogen, and very little in subsequent aggregations of the helium. In the region of the radio-elements, where we have abundant examples of the expulsion of helium atoms as α particles, it seems as if we could almost safely neglect this effect altogether. Thus radium has the atomic weight almost exactly 226, and the ultimate product almost exactly 206, showing that in five α- and four β-ray changes the mean effect is nil, and the atomic weights are, moreover, integers in terms of oxygen as 16, or helium 4. It is true that the atomic weights of both thorium and uranium are between 0·1 and 0·2 greater than exact integers, but it is difficult to be sure that this difference is real.

When, among the light elements, we come across a clear case of large departure from an integral value, such as magnesium, 24·32, and chlorine, 35·46, we may reasonably suspect the elements to be a mixture of isotopes. If this is true for chlorine, it suggests a most undesirable feature in the modern practice of determining atomic weights. More and more the one method has come to be relied upon, the preparation of the chloride of the element and the comparison of its weight with that of the silver necessary to combine with the chlorine, and with the weight of the silver chloride formed.

Almost the only practical method, and that a very laborious and imperfect one, which may be expected to resolve a mixture of isotopes is by long-continued fractional gaseous diffusion, which is likely to be the more effective the lower the atomic weight. Assume, for example, that chlorine were a mixture of isotopes of separate atomic weights 34 and 36, or 35 and 36. The 34 isotope would diffuse some 3 per cent. faster than the 36, and the 35 some 1·5 per cent. faster.

The determination of the atomic weight of chlorine in terms of that of silver has reached now such a pitch of refinement that it should be able to detect a difference in the end fractions of the atomic weight of chlorine, if chlorine or hydrogen chloride were systematically subjected to diffusion. It is extremely desirable that such a test of the homogeneity of this gas should be made in this way.

Clearly a change must come in this class of work. It is not of much use starting with stuff out of a bottle labelled "purissimum," or "garantirt," and determining to the highest possible degree of accuracy the atomic weight of an element of unknown origin. The great pioneers in the subject, like Berzelius, were masters of the whole domain of inorganic chemistry, and knew the sources of the elements in Nature first hand. Their successors must revert to their practice and go direct to Nature for their materials, must select them carefully with due regard to what geology teaches as to their age and history, and, before carrying out a single determination, they must analyse their actual raw materials completely, and know exactly what it is they are dealing with. Much of the work on the atomic weight of lead from mixed minerals is useless from failure to do this. Workers must rely more on the agreement, or disagreement, of a great variety of results by methods and for materials as different as possible than on the result of a single method pushed to the limit of refinement for an element provisionally purified by a dealer from quite unknown materials. The preconceived notion that the results must necessarily agree if the work is well done must be replaced by a system of co-operation between the workers of the world checking each other's results for the same material. A year ago anyone bold enough to publish atomic weight determinations which were not up to the modern standards of agreement among themselves would have been regarded as having mistaken his vocation. If these wider ideals are pursued, all the labour that has been lavished in this field, and which now seems to have been so largely wasted, may possibly bear fruit, and where the newer methods fail, far beyond the narrow belt of elements which it is possible to watch changing, the atomic weight worker may be able to pick up the threads of the great story. No doubt it is writ in full in the natural records preserved by rock and mineral, and the evidence of the atomic weights may be able to carry to a triumphant conclusion the course of elementary evolution, of which as yet only an isolated chapter has been deciphered.

The Structure of the Atom.

The third line of recent advance which does much to explain the meaning of isotopes and the periodic law starts from Sir Ernest Rutherford's nuclear theory of the atom, which is an attempt to determine the nature of atomic structure, which again is the necessary preliminary to the understanding of the third aspect in which the elements are, or may be, complex. That uranium and thorium are built up of different isotopes of lead, helium, and electrons is now an experimental fact, since they have been proved to change into these constituents. But the questions how they are built up, and what is the nature of the non-radio-active elements, which do not undergo changes, remain unsolved.

Prof. Bragg showed in 1905 that the α particles can traverse the atoms of matter in their path almost as though they were not there. So far as he could tell—and the statement is still true of the vast majority of α particles colliding with the atoms of matter—the α particle ploughs its way straight through, pursuing a practically rectilinear course, losing slightly in kinetic energy at each encounter with an atom until its velocity is reduced to the point at which it can no longer be detected. From that time the α particle became, as it were, a messenger that could penetrate the atom, traverse regions which hitherto had been bolted and barred from human curiosity, and on re-

emerging could be questioned, as it was questioned effectively by Rutherford, with regard to what was inside. Sir J. J. Thomson, using the electron as the messenger, had obtained valuable information as to the number of electrons in the atom, but the massive material α particle alone can disclose the material atom. It was found that though the vast majority of α particles re-emerge from their encounters with the atoms practically in the same direction as they started, suffering only slight hither and thither scattering due to their collisions with the electrons in the atom, a minute proportion of them suffer very large and abrupt changes of direction. Some are swung round, emerging in the opposite to their original direction. The vast majority, that get through all but undeflected, have met nothing in their passage save electrons, 8000 times lighter than themselves. The few that are violently swung out of their course must have been in collision with an exceedingly massive nucleus in the atom, occupying only an insignificant fraction of its total volume. The atomic volume is the total volume swept out by systems of electrons in orbits of revolution round the nucleus, and beyond these rings or shells guarding the nucleus it is ordinarily impossible to penetrate. The nucleus is regarded by Rutherford as carrying a single concentrated positive charge, equal and opposite to that of the sum of the electrons.

Chemical phenomena deal almost certainly with the outermost system of detachable or valency electrons alone, the loss or gain of which conditions chemical combining power. Light spectra originate probably in the same region, though possibly more systems of electrons than the outermost may contribute, while the X-rays and γ rays seem to take their rise in a deep-seated ring or shell around the nucleus. But mass phenomena, all but an insignificant fraction, originate in the nucleus.

In the original electrical theory of matter the whole mass of the atom was attributed to electrons, of which there would have been required nearly 2000 times the atomic weight in terms of hydrogen as unity. With the more definite determination of this number and the realisation that there were only about half as many as the number representing the atomic weight, it was clear that all but an insignificant fraction of the mass of the atom was accounted for. In the nuclear hypothesis this mass is concentrated in the exceedingly minute nucleus. The electromagnetic theory of inertia accounts for the greater mass if the positive charges that make up the nucleus are very much more concentrated than the negative charges which constitute the separate electrons. The experiments on scattering clearly indicated the existence of such a concentrated central positive charge, or nucleus.

The mathematical consideration of the results of α-ray scattering, obtained for a large number of different elements, and for different velocities of α ray, gave further evidence that the number of electrons, and therefore the + charge on the nucleus, is about half the number representing the atomic weight. But van der Broek, reviving an isolated suggestion from a former paper full of suggestions on the periodic law, which were, I think, in every other respect at fault, pointed out that closer agreement with the theory would be obtained if the number of electrons in the atom, or the nuclear charge, was the number of the place the element occupied in the periodic table. This is now called the atomic number, that of hydrogen being taken as 1, helium 2, lithium 3, and so on to the end of the table, uranium 92, as we now know. For the light elements it is practically half the atomic weight, for the heavy elements rather less than half.

I pointed out that this accorded well with the law of radio-active change that had been established to hold over the last thirteen places in the periodic table. This law might be expressed as follows:—The expulsion of the α particle carrying two positive charges lowers the atomic number by two, while the expulsion of the β particle, carrying a single negative charge, increases it by one. In ignorance of van der Broek's original suggestion, I had, in representing the generalisation, shown the last thirteen places as differing unit by unit in the number of electrons in the atom.

Then followed Moseley's all-embracing advance, showing how from the wave-lengths of the X-rays, characteristic of the elements, this conception explained the whole periodic table. The square roots of the frequency of the characteristic X-rays are proportional to the atomic numbers. The total number of elements existing between uranium and hydrogen could thus be determined, and it was found to be ninety-two, only five of the places being vacant. The "exceptions" to the periodic law, such as argon and potassium, nickel and cobalt, tellurium and iodine, in which an element with higher atomic weight precedes instead of succeeding one with lower, were confirmed by the determination of the atomic numbers in every case. From now on, this number, which represents the + charge on the nucleus rather than the atomic weight, becomes the natural constant which determines chemical character, light, and X-ray spectra, and, in fact, all the properties of matter except those that depend directly on the nucleus—mass and weight on one hand, and radio-active properties on the other.

What, then, were the isotopes on this scheme? Obviously they were elements with the same atomic number, the same *net* charge on the nucleus, but with a differently constituted nucleus. Take the very ordinary sequence in the disintegration series, one α and two β rays being successively expelled in any order. Two + and two − charges have been expelled, the *net* charge of the nucleus remains the same, the chemical character and spectrum the same as those of the first parent, but the mass is reduced four units because a helium atom, or rather nucleus, has been expelled as an α particle. The mass depends on the *gross* number of + charges in the nucleus, chemical properties on the difference between the gross numbers of + and − charges. But the radio-active properties depend not only on the gross number of charges, but on the constitution of the nucleus. We can have isotopes with identity of atomic weight, as well as of chemical character, which are different in their stability and mode of breaking up. Hence we can infer that this finer degree of isotopy may also exist among the stable elements, in which case it would be completely beyond our present means to detect. But when transmutation becomes possible such a difference would be at once revealed.

The case is not one entirely of academic interest, because it is probable that the reconciliation of the conflicting views of the geologists and chemists who concluded that lead was not the ultimate product of thorium, and those who by atomic weight determinations on the lead have shown that it is, depends probably on this point.

As has long been known, thorium-C, an isotope of bismuth, disintegrates dually. For 35 per cent. of the atoms disintegrating, an α ray is expelled, followed by a β ray. For the remaining 65 per cent. the β ray is first expelled, and is followed by the α ray. The two products are both isotopes of lead, and both have the same atomic weight, but they are not the same. More energy is expelled in the changes of the 65 per cent. fraction than in those of the 35 per cent. Unless they are both completely stable a difference of period of change is to be anticipated.

The same thing is true for radium-C, though here all

but a very minute proportion of the atoms disintegrating follow the mode followed by the 65 per cent. in the case of thorium-C. The product in this case, radium-D, which, of course, is also an isotope of lead, with atomic weight 210, is *not* permanently stable, though it has a fairly long period, twenty-four years. The other product is not known to change further, but then, even if it did, it is in such small quantity that it is doubtful whether the change would have been detected. But, so far as is known, it forms a stable isotope of lead of atomic weight 210, formed in the proportion of only 0·03 per cent. of the whole.

Now the atomic weight evidence merely shows that *one* of the two isotopes of lead formed from thorium is stable enough to accumulate over geological epochs, and it does not necessarily follow that both are. Dr. Arthur Holmes has pointed out to me that the analysis I gave of the Ceylon thorite leads to a curiously anomalous value for the age of the mineral. The quantity of thorium lead per gram of thorium is 0·0062, and this, divided by the rate at which the lead is being produced, $4·72 \times 10^{-11}$ grams of lead per gram of thorium per year, gives the age as 131 million years. But a Ceylon pitchblende, with uranium 72·88 per cent., and lead 4·65 per cent., and ratio of lead to uranium as 0·064, gives the age as 512 million years. Dr. Holmes regards the two minerals as likely to be of the same age, and the pitchblende to be, of all the Ceylon results, the one most trustworthy for age measurement.

If we suppose that, as in the case of radium-D, the 65 per cent. isotope of lead derived from thorium is *not* stable, and that only the 35 per cent. isotope accumulates, the age of the mineral would be 375 million years, which the geologists are likely to consider much nearer the truth. But the most interesting point is that, if we take the atomic weight of the lead isotope derived from uranium as 206·0, and that derived from thorium as 208·0, and calculate the atomic weight of the lead in Ceylon thorite, assuming it to consist entirely of uranium lead and of only the 35 per cent. isotope from thorium, we get the value 207·74, which is exactly what I found from the density, and what Prof. Hönigschmid determined (207·77) (compare NATURE, May 24, p. 244).

The question remains: If this is what occurs, what does this unstable lead change into? If an α particle were expelled mercury would result, or if a β particle bismuth, two elements of which I could find no trace in the lead group separated from the whole 20 kilos of mineral. But if an α and a β particle were both expelled, the product would be thallium, which is present in amount small, but sufficient for chemical as well as spectroscopic characterisation. If the process of disintegration does proceed as suggested, it should be possible to trace it, for this particular lead should give a feeble specific α or β radiation, in addition, of course, to that due to other lead isotopes. So far it has not been possible to test this. In the meantime, the explanation offered is put forward provisionally as being consistent with all the known evidence.

Looking for a moment, in conclusion, at the broader aspects of the new ideas of atomic structure, it seems that though a sound basis for further development has been roughed out, almost all the detail remains to be supplied. We have got to know the nucleus, but, beyond the fact that it is constituted, in heavy atoms, of nuclei of helium and electrons, nothing is known; whilst, as regards the separate shells or rings of electrons which neutralise its charge and are supposed to surround it like the shells of an onion, we really know nothing yet at all. The original explanation, in terms of the electron, of the periodicity of properties displayed by the elements still remains all that has been attempted. We may suppose that as we pass through the successive elements in the table one more electron is added to the outermost ring for each unit increase in the charge on the nucleus, or atomic number, and that when a certain number, 8 in the early part of the table, and 18 in the later, has been added, a complete new shell or ring forms, which no longer participates directly in the chemical activities of the atom. Thanks, however, to Moseley's work, this, now, is not sufficiently precise. For we know the exact number of the elements and the various atomic numbers at which the remarkable changes, in the nature of the periodicity displayed, occur. Any real knowledge in this field will account not only for the two short initial periods, but also for the curious double periodicity later on, in which the abrupt changes of properties in the neighbourhood of the zero family alternate with the gradual changes in the neighbourhood of the eighth groups. The extraordinary exception to the principle of the whole scheme presented by the rare-earth elements remains a complete enigma, none the less impressive because, beyond them in the table, the normal course is again resumed and continues to the end. This latter, highly significant, feature of the periodic table is one of the definite conclusions following from the chemical characterisations of the numerous radio-elements.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Mr. C. O. Blagden has been appointed as from September 1 next to the new University readership in Malay, tenable at the School of Oriental Studies.

The cordial thanks of the Senate have been voted to Sir Ratan Tata for a further donation of 1400*l*. a year for five years in continuation of his previous benefaction for the promotion of the study of the principles and methods of preventing and relieving destitution and poverty. This will be expended on behalf of the Ratan Tata Department of Social Science and Administration in the London School of Economics, which will be controlled by a joint committee appointed partly by the Senate and partly by the school.

The following doctorates in science have been conferred:—*D.Sc. in Botany*, Miss F. A. Mockeridge, an internal student, of King's College, for a thesis entitled "Some Effects of Organic Growth-promoting Substances (Auximones) on the Soil Organisms concerned in the Nitrogen Cycle." *D.Sc. in Geology*, Mr. Arthur Holmes, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Contributions to the Geology of Mozambique." *D.Sc. in Mathematics*, Mr. G. N. Watson, an internal student, of University College, for a thesis entitled "Various Methods of Approximation, with Special Reference to Bessel Functions and Gamma Functions." *D.Sc. in Physics*, Mr. W. Wilson, an internal student, of King's College, for a thesis entitled "The Complete Photo-electric Emission and the Emission of Electrons from Hot Bodies." *D.Sc. in Zoology*, Miss K. M. Parker, an internal student, of University College, for a thesis entitled "The Development of the Hypophysis Cerebri, the Pre-oral Gut, and Related Structures in the Marsupialia." *D.Sc.* (*Economics*), Miss Kate Hotblack, an internal student, of the London School of Economics, for a thesis entitled "Chatham's Colonial Policy."

Grants have been made out of the Dixon fund for

the year 1917–18 as follows:—25*l*., Mr. Nilratan Dhar, for research on temperature coefficients of chemical reactions; 30*l*., Mr. H. R. Nettleton, for researches on the measurement of the Thomson effect in wires; 20*l*., Dr. D. Ellis, towards the cost of publication of a book on "Iron Bacteria"; 100*l*., Mr. Birbal Sahni, to enable him to carry out botanical investigations at Cambridge.

Regulations have been adopted for the degree of B.Sc. in horticulture for external students.

THE appointment is announced of Mr. G. Gerald Stoney to be professor of mechanical engineering in the Manchester School of Technology. Mr. Stoney has had a seat on the Board of Inventions and Research under Lord Fisher, and on the Engineering Committee of the Advisory Council for Scientific and Industrial Research. Prospectuses of the university courses in the School of Technology for the session 1917–18 are now available, and provide full particulars of the work expected from students proceeding to the degrees of Bachelor of Technical Science and Master of Technical Science.

THE report of the conference convened by the Workers' Educational Association, held on May 3 last in the Central Hall, Westminster, has just been published. The findings of the conference are the more impressive since they represent the conclusions of a widely representative body of delegates, numbering between 700 and 800, not only from labour organisations and co-operative societies, but from educational associations, teachers' organisations, local authorities, and the universities. The resolutions call for the establishment of small and easily accessible nursery schools for the due care and nurture of young children from two years of age until six; the abolition of all exemptions from school attendance up to fourteen; the raising of the school age up to fifteen within five years, and to sixteen within three further years; the provision of maintenance allowance over the age of fourteen, and the abolition of all child labour for wages during compulsory full-time attendance; the immediate reduction of the size of classes to forty pupils, and ultimately to thirty; the establishment of adequate medical inspection and treatment of all scholars and improvement in school meals; better facilities for games, swimming, and open-air teaching, together with means of conveyance where children reside more than a mile from school. The policy of the conference was declared to be the establishment of a broad highway so as to ensure the highest facilities of education to all capable scholars. To this end it is proposed to limit the hours of labour for all young persons under eighteen years of age to twenty-five hours per week, and to establish compulsory part-time education for such persons of not fewer than twenty hours per week, and that such education shall be directed to the full development of the bodies, minds, and characters of the pupils. Further, it is demanded that free, full-time secondary education shall be provided, together with an adequate supply of scholarships to enable scholars of ability to enter a university. In order to secure the necessary supply of good teachers of both sexes, it is claimed that adequate salaries shall be paid and pensions provided with equal pay for equal service. Each local education authority is to be required to submit a complete scheme for its area to the Board of Education, 75 per cent. of the total cost of which shall be met from the National Exchequer, and where the conditions are inadequately fulfilled there shall be a reduced percentage.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, June 18.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: The limiting equilibrium of a sandy mass under given conditions.—C. **Guichard**: Surfaces such that the Laplace equation of the network formed by the lines of curvature is integrable.—A. **Righi**: The ionisation of the X-rays in a magnetic field. Earlier work by the author on the influence exerted by the magnetic field on the phenomena of discharge pointed to the existence of a new action of the field on gases tending to increase their ionisation. This effect, to which the name magneto-ionisation is given, may be explained on the assumption that the electromagnetic force acting upon a satellite electron in the atom causes a variation in the energy necessary to separate the electron from the atom. In the present paper a direct experimental proof of this effect is given.—R. Bourgeois was elected a member of the section of geography and navigation in succession to the late M. Hatt, and E. Solvay a correspondant for the section of chemistry in the place of the late Sir Henry Roscoe.—G. D. **Birkhoff**: A generalisation of Taylor's series.—H. **Duport**: The law of universal attraction.—Ed. **Chauvenet**: The zirconyl sulphates. The six combinations of zirconia and sulphuric acid described in a previous paper are considered from the points of view of modes of formation and probable composition. All are represented as zirconyl salts containing the group ZrO.—J. **Bougault**: The action of iodine on alkalies. A study of the oxidising powers of iodine in presence of caustic soda, sodium carbonate, and sodium bicarbonate.—M. **Guerbet**: The condensation, under the action of potash, of *cyclo*hexanol with *iso*propyl alcohol. The synthesis of *cyclo*hexyl*iso*propyl alcohol.—M. **Sauger**: The time of fall of a stone to the centre of the earth. The problem is considered, taking into account the variation of the density of the globe with the depth. The time found is 19m. 15s.; on the assumption of a density equal to the mean density the time found is 79s. greater.—L. **Daniel**: The preservation of our oaks. The spread of the fungus causing the *Blanc du Chêne* is shown to be connected with the method of lopping the trees. The usual practice is a drastic lopping every seven years. This destroys the normal moisture equilibrium of the tree; the absorptive apparatus remains intact, but the reduction in the leaf surface causes the retention of an excess of moisture in the tissues, a condition favourable to the spread of the fungus. It has been proved that trees just lopped are more easily attacked than those lopped the preceding year; the latter are more easily attacked than those trees lopped several years earlier. A modified system of lopping is proposed, but it is pointed out that State action will probably be necessary, since the interests of the farmers and owners are opposed, and it is not likely that the cultivators will willingly change their present system of working.—Mme. Marie **Phisalix**: The parotid poison gland of the Colubridæ.—W. **Kopaczewski**: Researches on the serum of *Muraena helena*. The serum of this species is very toxic. A dose of 0·05 c.c. is fatal to a guinea-pig, an amount corresponding to 4·19 mgr. of dry substance. 0·4 c.c. of serum killed a rabbit in four minutes, and 1·5 c.c. killed a dog (5 kilograms) in seventy minutes.—A. **Krempf**: A new endoglobular hematozoa in man (*Haemogregarina hominis*). The organism was isolated from the hypertrophied spleen of a Chinese from the neighbourhood of Tientsin. Only one case is described, but it would appear that the disease caused by this organism is common in some parts of China.

June 25.—M. A. d'Arsonval in the chair.—A. **Lacroix**: The transformation of some basic eruptive rocks into amphibolites.—G. **Bigourdan**: The observations attributed to Prince Louis of Valois; and on the astronomer, Jacques Valois. The observations attributed to Prince Emmanuel of Valois (1596 to 1663) were really due to Jacques Valois (or de Valois), whose life is only known through his correspondence.—L. **Maquenne** and E. **Demoussy**: The influence of water and mineral matter on the germination of peas. The presence of traces of mineral matter derived from glass favours the germination of seeds, and if it is required to study the process of germination in distilled water, it is necessary to use a quartz condenser in making the distilled water and to store the water in quartz or platinum vessels. Comparative experiments, germinating peas in quartz and glass vessels, always gave a better development of roots in the glass than in the quartz vessels. The magnitude of the effects observed was unexpected, and it is pointed out that in botanical and physiological experiments attention must always be paid to the possible intervention of soluble products derived from the glass.—A. **Gautier**: An artificial soil, nearly free from all mineral or organic material, suitable for the study of plant cultures and for the examination of the influence of various chemical manures. The medium proposed is powdered charcoal (*braise de boulanger*) first heated to redness, then boiled with hydrochloric acid, and extracted with distilled water. This may advantageously replace glass powder, cotton, or sand media for botanical cultures. It has been especially useful in studying the effects of traces of fluorides on vegetation.—E. **Ariès**: The specific heats of fluids maintained in the saturated state.—G. **Julia**: Binary indeterminate conjugated forms remaining invariant by a group of linear substitutions.—W. **Sierpinski**: An extension of the notion of the density of ensembles.—E. **Jablonski**: Contribution to the study of the most general case of shock in a system of material points submitted to Newton's law.—E. **Belot**: Some principles applicable to comparative planetography.—P. Th. **Dufour**: Experimental researches on the terrestrial tetrahedron and the distribution of land and sea. Globules of liquid paraffin wax are immersed in methyl alcohol of the same density as the paraffin, and carried to a temperature slightly above the melting point of the wax. On allowing to cool slowly, the liquid globule remains perfectly spherical. If the bath is kept in motion, so as to produce a regular solidification, symmetrical tetrahedral globules are obtained, with convex faces and rounded points. The effect of variations in the density of the earth's crust on the form assumed by slow cooling is discussed in connection with these experiments.—A. **Leduc**: The expansion of argon and neon. Internal pressure in the monatomic gases. The coefficient of expansion of argon between 5·47° C. and 29·07° C. is 0·003664; of neon between 11·95° C. and 31·87° C., 0·003669, with a possible error of 2 in the last figure.—P. **Chevenard**: An anomaly of cementite in carbon steels, annealed, tempered, or half-tempered.—J. **Bougault**: A new method of estimating aldehydic sugars. The method is based on the oxidation to the corresponding acid by iodine and sodium carbonate, the iodine used being determined. A small correction is required on account of a secondary reaction.—Ph. **Glangeaud**: The ancient glaciers of the Monts-Dore volcanic massif.—L. **Moreau**: Radiological researches on the angle of inclination of the human heart. The angle of inclination of the normal human heart is usually given in the treatises on anatomy as between 55° and 60°. One hundred subjects examined by a radiological method gave a figure which, in 74 per cent. of the cases examined, was between 65° and 78°.—L. G. **Seurat**: The evolution of *Maupasina Weissi*.—H. **Vallée** and L. **Bazy**: The active vaccination of man against tetanus. The liquid injected consisted of a tetanotoxin neutralised with a solution of iodine in potassium iodide. Vaccinated rabbits resisted the effect of a quantity of toxin sufficient to kill 2000 kilograms of living substance. The vaccination treatment is more especially proposed to combat latent tetanus.

BOOKS RECEIVED.

A Bibliography of Fishes. By B. Dean. Enlarged and edited by C. R. Eastman. Vol. i. Pp. x+718. (New York: American Museum of Natural History.)

Bibliography of the Published Writings of H. Fairfield Osborn for the Years 1877–1915. Second edition. Part i., Classified by Subject. Part ii., Chronologic. Bibliography. Pp. 74. (New York: American Museum of Natural History.)

A Chemical Sign of Life. By S. Tashiro. Pp. ix+142. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1 dollar, or 4s. net.

Manuals of Health. I., Food. By Dr. A. Hill. Pp. 64. (London: S.P.C.K.) 9*d*.

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THURSDAY, AUGUST 2, 1917.

AMERICAN AND ANTARCTIC GEOLOGY.

(1) *Geology: Physical and Historical.* By Prof. H. F. Cleland. Pp. 718. (New York: American Book Company.) Price 3.50 dollars.

(2) *British Antarctic Expedition,* 1907–9. *Under the Command of Sir E. H. Shackleton, C.V.O. Reports on the Scientific Investigations. Geology:* Vol. ii., *Contributions to the Palaeontology and Petrology of South Victoria Land.* By W. N. Benson and others. Pp. vii+270+plates 38. (London: W. Heinemann, 1916.) Price 3 guineas net.

(1) PROF. CLELAND'S volume is an attempt to provide a summary of physical and historical geology which shall be both interesting to read and serviceable as a students' text-book. It has many excellent features; it includes a well-selected collection of 587 illustrations and, as the result of the author's wide reading, many interesting facts which are new to general text-books. Its most valuable contribution is in the sections on vertebrate palæontology, which summarise the evolution of most orders of mammals instead of referring only to a few. The account of American stratigraphy and palæogeography should be useful to British readers, and the convenient lists of folios of the United States Geological Survey which illustrate various physiographic forms should increase the educational use of those most instructive maps.

The main defect of the book is that the author, perhaps owing to haste, has not always fully digested the information collected, so that minor errors and inconsistencies are numerous, and space is sometimes devoted to obsolete theories of which current views are also given. Among the mistakes of fact are that the Zambezi flows through a deep gorge above the Falls; that Australia has no native grasses, and that its indigenous fauna belongs to the early Tertiary; that the sea-urchins experienced little change in Palæozoic times (compare Bothriocidaris and Melonites!); that *Thamnastrea prolifera* ranged throughout the Mesozoic; and that eskers are not usually more than a mile long. In a future edition the author might alter the statement regarding Spirula (p. 531) and abandon his inference from the steam-cloud of Stromboli (p. 339).

The student will pounce on many statements which he will be quicker to compare than to reconcile; thus, the Permian is sometimes a subdivision of the Carboniferous, and at others an independent system. Lava, on p. 298, is wisely restricted to rocks which "issue from the earth," yet the intrusive sheet which forms the Palisades of the Hudson are called lava, and some mud volcanoes are attributed to the action of lava at some depth below the surface. Hanging valleys are said to be proof of glacial action on p. 163, although elsewhere in the book glaciers are said to have slight powers of erosion on smooth rock surfaces, and hanging valleys are described which are due to non-glacial agencies. The author gives two comparative diagrams of a group of ridges and valleys, one with spurless walls and faceted ends, the other with serrated crests; yet the former is included as an illustration of stream erosion and the latter as mainly due to ice action. The short chapters on rocks and minerals are below the standard of the rest of the book, and students are unlikely to derive correct impressions from the statements that hornblende has "slender flat crystals," that syenite is granite without quartz, and that diorite and gabbro consist respectively of hornblende and pyroxene with "felspar of any kind."

The effort to simplify palæontology is responsible for the division of the Palæozoic corals into the chain corals, cup corals, and honeycomb corals —which are undefined popular terms that do not form satisfactory classificatory subdivisions.

The references to authorities indicate that the work is based unduly on text-books and semi-popular works rather than on original authorities. Thus, in the accounts of the vertebrates, Hutchinson's "Extinct Monsters" is repeatedly referred to, while in the summary of the evolution of the elephants no direct reference is made to Dr. Andrews, whose results are quoted second-hand. Some pages are devoted to early man, but there is no mention of Eoanthropus.

Though Prof. Cleland's text-book will be useful, it is not up to the usual high standard of American geological literature.

(2) The second volume of the Geological Reports on Sir Ernest Shackleton's Antarctic Expedition of 1907–9 is a magnificent volume prepared through funds raised in part by a lecture tour by Prof. (now Major) Edgeworth David. He has been unable, owing to his important services on the Western front, to edit the volume, a work undertaken by Sir Douglas Mawson. Prof. David has contributed a preface, in which he explains why he considers that the ice-barrier tongues from the Antarctic glaciers are afloat and do not rest on esker-like embankments built of their moraines and subglacial gravels.

The volume consists of a chapter on ice structures by Sir Douglas Mawson and of thirteen technical studies on the geological collections brought back by the expedition. Sir Douglas Mawson's ice studies were made on the ice of the lakes, of the sea, and of the stalactites in the ice caves; his work shows how the ice structures vary with the conditions which determine the elimination and distribution of the brine, and they throw further light on the conversion of névé into glacier ice. Mr. Chapman contributes a series of reports on the foraminifera and ostracods in mud from the floor of the Ross Sea and from various raised marine deposits on the adjacent coasts. Mr. Hedley describes the mollusca from the same marine beds, and remarks that their preservation shows that "their geological age is of the slightest." Mr. Chapman establishes some new species, and reports the presence of some Arctic species, especially *Saccammina sphaerica,* which

would give some support to Murray's theory of bipolarity had not the evidence against it by the rest of the Antarctic fauna been overwhelming. He also furnishes further evidence that some arenaceous foraminifera select the material for their shells, since *Reophax spiculifera* rejects sand grains and uses only sponge spicules, which it builds up into funnel-shaped chambers. Mr. Chapman's most interesting Antarctic fossil is a Cambrian calcareous alga, which he has referred to Bornemann's genus Epiphyton from Sardinia as a new species, *E. fasciculatum.*

The rest of the volume consists of a series of petrologic reports by Messrs. Jensen, Allan Thomson, Benson, Walkom, Woolnough, Skeats, and Cotton, Sir Douglas Mawson, and Miss Cohen. Dr. Jensen describes some samples of Antarctic soil on which, though due to mechanical disintegration rather than to chemical decay, plants were found to grow when kept adequately warm. Dr. Jensen also contributes a chapter on the interesting alkaline rocks of Mount Erebus, and discusses the classification of the kenytes and their relations to the trachydolerites. Dr. Allan Thomson has carefully investigated some inclusions in the trachytes and kenytes, and founded for one series a new rock type, *microtinite,* so called as they are aggregates of plagioclase felspars. He discusses the terminology of included rock fragments, and adopts Lacroix's terms "homœogenous" and "enallogenous" as the best yet proposed.

The volume has an excellent index to both volumes. Mr. Dun's promised bibliography of Antarctic geology has been postponed, but its early publication would be a great boon, as the subject has now a very scattered literature.

RADIO-MECHANICS.

Radio-dynamics: The Wireless Control of Torpedoes and Other Mechanisms. By B. F. Miessner. Pp. v+206. (London: Crosby Lockwood and Son, 1917.) Price 9*s*. net.

THIS little volume deals with a subject of considerable interest at the present time, viz. the control of torpedoes or other vessels of war by means of electromagnetic waves. The author has, however, unnecessarily increased the bulk of his book by the introduction of a good deal of irrelevant matter, and by space given to elementary facts connected with wireless telegraphy which might quite well have been taken as familiar to any reader likely to be interested in it. Moreover, he has rather overestimated the importance of the early work of some American investigators, such as Dolbear and Tesla, and done insufficient justice to that of European workers, such as Marconi, Fleming, Lodge, Muirhead, E. Wilson, and others. Too much space is given to the description of methods of communication, such as those of earth conduction, ultra-violet light, and infrared rays, which have never become practically useful.

The proper discussion of apparatus for the control of mechanism at a distance by means of electromagnetic waves does not begin until chap. xi., p. 78, of the book, and even then the treatment is of a rather sketchy character. The essential principles involved are quite easy to understand. A torpedo or other vessel to be directed must have on it some source of motive power such as storage cells, compressed air, or a petrol motor. This power drives the screw propeller and moves the vessel. Also the same source of power is used to put the helm to port or starboard or straight. We have then to set in motion some motor or gearing which starts or stops the driving power, or engages or changes the mechanism for steering. The boat is, therefore, provided with a mast carrying an aerial wire or antenna, by means of which electromagnetic waves sent out from a shore station are absorbed. The feeble electric currents thus set up in the aerial wire are utilised to set in motion a sensitive relay, and this in turn has to control the power which steers or propels the boat.

The first difficulty is the nature of the radiation detector which is connected to the antenna. In the early days of wireless telegraphy this was always some form of coherer, generally the metallic-filings coherer of Branly as modified by Marconi or Lodge. This detector is, however, rather uncertain in action and requires the addition of an automatic tapper to bring it back to the sensitive state after it has received and responded to a signal. Hence of late years it has been entirely ousted as a wave detector by more certain appliances, such as Marconi's magnetic detector, the Fleming vacuum valve, or some form of crystal detector. These modern detectors operate with or control such small alternating currents that they cannot with certainty set in action any electromagnetic relay capable of being used on board a small vessel at sea.

The first difficulty, therefore, in connection with the mechanism of radio-directed vessels is the selection of a suitable wave detector and of a relay. The author found that a form of Lodge-Muirhead self-acting coherer, called the steel-wheel coherer, was a useful one, and he constructed a suitable relay by modifying a type of movable-coil galvanometer. Even when such arrangements are perfected so that the sending out of electromagnetic waves which impinge on the torpedo aerial can be made to steer it by setting in action some mechanism which throws over the rudder to one side or the other, there still remains the difficulty of rendering the radio-receiver immune to vagrant electric waves or to intentional attempts to mis-steer the boat on the part of an enemy.

The reader will find in chap. xiv. an account of the work done in attempts to develop a radio-steered torpedo at the laboratory of Mr. John Hays Hammond, jun. In chaps. xv. and xvi. the difficulties connected with control and interference are discussed.

Although small vessels have been controlled in this manner by electromagnetic waves up to a distance of ten miles or rather more, the practical problem of certain control cannot be said to have been solved. The present book deals, therefore,

with an experimental stage of the subject, which may, however, have considerable possibilities of actual utility in warfare.

In any future edition of his book the author would be well advised to cut out all unessential matter. He is not a safe guide on points of history or priority in relation to radio-telegraphic invention. His statement on p. 32 as to "later improvements" is absurdly inaccurate. On pp. 105 and 106 he misspells the name of Prof. E. Branly, the inventor of the metallic-filings coherer. On p. 173 he gives exclusive credit for the vacuum valve detector to Lee de Forest, apparently in entire ignorance that the Court of Appeals in the United States has confirmed Judge Mayer's decision that the de Forest audion is an infringement of the Fleming oscillation valve. He is also seemingly unaware that the so-called Dolbear system of wireless telegraphy was never operative. In spite of the fact that there is a free use of photographs of apparatus which are insufficiently described in the text, the reader who is desirous of learning what can be done in the radio-control of torpedoes will find a good deal of suggestive research described in this little book. J. A. F.

THE ACTION OF ENZYMES.

The Method of Enzyme Action. By Dr. J. Beatty. With Introduction by Prof. E. H. Starling. Pp. ix+143. (London: J. and A. Churchill, 1917.) Price 5*s*.

TWO-THIRDS of this book is devoted to an excellently clear and concise account of the facts and theories to be found in the books named in the preface, so far as they are connected with the action of enzymes. What is new, and the chief object of the book, is the suggestion of a hypothesis of enzyme action. The details can be adequately grasped only from the full description. It is based on two assumptions: (1) the possibility of "combination" between molecules, and (2) the loosening of internal bonds in one or both of the combining molecules as a result of this union. It is held that the action of all enzymes can be reduced to the combination with H and OH radicles derived from water. These radicles are "activated" by the power possessed by an enzyme of "attracting" one or the other. This is a general or unspecific property, but each enzyme has also a specific power of adsorbing some particular substrate. The author will, no doubt, admit that considerable further explanation is required as to the means by which the activation is effected, and criticism is difficult until more is known of the nature of the atom itself and of the way in which it is united to other atoms.

The hypothesis deserves to be kept in mind as more knowledge is gained of the action and the nature of enzymes. At present it is not easy to imagine ways of putting it to experimental test. Indeed, it must not be forgotten that the fundamental assumptions are not universally accepted. The present writer is inclined to think that the use of the word "combination," although very common, in speaking of the union between molecules and even of adsorption, is apt to lead to an obscuring of the great, salient facts of true chemical union. There are, as it seems, various stages of "combination," leading from adsorption, through molecular compounds, to cases where the change of properties is of the most striking kind.

It is somewhat unfortunate that the new hypothesis appears to involve the explanation of all catalytic action by the formation of intermediate compounds. This has been shown actually to take place in one case alone of heterogeneous catalysis, and since the compounds are only supposed to exist momentarily, it seems somewhat hopeless to expect a proof or disproof of their existence. The possibility of representing a reaction by a chemical equation does not necessarily show that it takes place in that way. The division of catalysts into inorganic and enzymes would be better replaced by that into homogeneous and heterogeneous, the latter to include enzymes. There are more differences between catalysis in homogeneous and heterogeneous systems than between inorganic heterogeneous catalysts and enzymes. In fact, more knowledge of the mechanism of heterogeneous catalysis is greatly to be desired. In future developments of his hypothesis the author might also find it of advantage to consider it more fully in the light of the doctrines of energetics.

W. M. B.

OUR BOOKSHELF.

Clinical Bacteriology and Haematology for Practitioners. By Dr. W. D'Este Emery. Fifth edition. Pp. xiii+plates xi+pp. 310. (London: H. K. Lewis and Co., Ltd., 1917.) Price 9*s*. net.

A NEW edition of Emery's "Clinical Bacteriology and Hæmatology" is always welcome, for it is a most useful book for the practitioner and for laboratory work. The general plan has been maintained in this fifth edition, but the text has been revised, some new matter added, and some more illustrations have been inserted.

In the section dealing with syphilis the McIntosh and Fildes method of performing the Wassermann reaction has been inserted in addition to the author's own method, and we think the author has been well advised to do this.

The Dreyer method of performing the agglutination test for typhoid fever is also described in full as well as earlier methods.

Cerebrospinal fever and the recognition of the meningococcus are dealt with more fully than previously, and the examination of carriers is described. Even now this section is none too long, and might be extended with advantage. We doubt if it is wise ever to rely on ordinary agar as a culture medium for this organism, as is suggested.

Malaria is described very briefly, and no mention is made that the crescents of sub-tertian fever are free in the blood-plasma and are not

intra-corpuscular. We are surprised also to find no reference to amœbic dysentery; with many cases now coming from abroad the practitioner is quite likely to meet with this disease. While pointing out these few slight blemishes, we can cordially recommend this book as on the whole a simple and reliable guide to clinical bacteriology and pathology.

Soil Conditions and Plant Growth. By Dr. E. J. Russell. Third edition. Pp. viii+243. (London: Longmans, Green, and Co., 1917.) Price 6*s*. 6*d*. net.

THIS book is, as the title implies, concerned with the relationship between soil and plant. After an introductory historical account of the subject the author describes the constitution of the soil and the various factors of plant growth. In the development of these topics and of the question of the relation of the plant to its soil environment, the reader is kept constantly in touch with the best original work at home and abroad.

The author has made numerous additions in his third edition, and has considerably expanded those portions treating of the biological conditions in soils. He has also added a chapter on the colloidal properties of the soil, in which he brings the reader abreast of the recent researches and disputes of Continental workers, as well as the latest Rothamsted work on the interaction of dilute acids and soil colloids.

It is superfluous to say that the book is well written. There is an ample bibliography, which should be invaluable to the investigator in any branch of the subject.

The study of the relationship between soil and plant is exceedingly complex. Progress can only be made by studying the soil in every aspect of importance to the plant. It is a pity that so much labour should have been expended during past years in haphazard manurial trials, designed to instruct the farmer, but yielding generally a scanty harvest of accurate information. Soil investigators owe a debt to Dr. Russell and his predecessors at Rothamsted for enlarging the study of the soil into a respectable field of scientific activity.

G. W. ROBINSON.

Lezioni di Antropologia. By Prof. Fabio Frassetto. Vol. iii. Pp. xiii+422. (Bologna: Mareggiani, 1917.) Price 20 lire.

IN the thirteen lectures contained in this volume Prof. Frassetto covers that part of his course which is devoted to the limbs—their evolution, development, and morphology. In his lectures dealing with the methods which are to be applied to the measurement of bones and to the exact estimate of their anthropological characters he has introduced much that is new and valuable. All through these lectures is reflected that spirit of mutual understanding which has existed between the anatomists of Italy and England since Harvey's time. There is no better summary of the contributions which British anatomists have made to physical anthropology than is to be found in these clearly written and excellent lectures by Prof. Frassetto.

A. K.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Radiation of the Stars.

I AM sorry that the only reply I can make to Prof. Eddington's remarks in NATURE of July 5 is that his amended equation seems to me neither to be true nor to lead to his supposed laws. But perhaps I may be permitted to offer a few remarks on the general problem.

Suggested sources of stellar energy fall into two broad classes—gravitational and electrical, the latter including chemical and radio-active sources. Of the former the Helmholtz contraction is by far the most powerful source of energy; the contraction of our sun from a state of infinite rarity would provide energy for about 20,000,000 years of radiation at the present rate.

An upper limit to the capacity of electrical sources can be calculated in a way I have not seen elsewhere. Our sun's mass is 2×10^{33} grm., its radiation about 4×10^{33} ergs per second. Thus to radiate for 20,000,000 years (or, say, 7×10^{14} sec.) at its present rate, each gram of matter must provide on the average 14×10^{14} ergs of energy. A gram of matter contains 3×10^{23} negative electrons, so that the average electron must provide $4\cdot7\times10^{-9}$ ergs of energy, corresponding to a fall through a potential difference of 10 electrostatic units, or 3000 volts. This is the energy of falling from infinity to a distance of only $4\cdot7\times10^{-10}$ cm. from a nucleus $10e$, and so is probably much greater than any energy actually available from changes of electrical structure; it is, of course, enormously greater than any known ionisation potentials.

It accordingly looks as though the Helmholtz contraction will provide much more energy than any other source, and we must apparently adjust our views to the time-scale set by the contraction theory.

If this is accepted, it will be obvious that the calculation of stellar temperatures and emissions of energy cannot be a steady-state problem at all. I do not see how, in any case whatsoever, any new knowledge can be gained from calculations which assume the star to be in a steady state, for the calculated rate of emission can come to nothing but the previously assumed rate of generation of energy inside the star. For progress to be made, this big and difficult problem must, I think, be attacked on dynamical, and not on statical, lines.

July 7.

I HOPE I may state my grounds for disbelief in Prof. Eddington's results more clearly. The results are readily combined in the one result that the total emission depends only on M, and varies as M. Prof. Eddington claims to obtain this result in two ways. In his original paper he assumes (*M.N.*, vol. lxxvii., p. 20) a rate of generation $4\pi M\epsilon$, and after much calculation obtains a result which, on introducing the omitted constants, reduces (*l.c.* p. 29, equations (29) and (25)) to exactly $4\pi M\epsilon$, proving my point. Again, in NATURE of June 14, Prof. Eddington claims to obtain a result which I do not understand, but which is necessarily contradictory to the foregoing, since the emission cannot now involve ϵ at all. He apparently says:—"Tell me the mass of a star and I will tell you its output of radiation without knowing the rate at which energy is being generated in its interior; I

can do this by assuming the star to be in a steady state." This I cannot believe to be possible.

Prof. Eddington now says that the star "must settle into a state of density and temperature which would produce an outward flow at the required rate." Perhaps; but surely Prof. Eddington's original contention was that the rate of outward flow could not be affected by density and temperature, but depended only on the mass.

J. H. Jeans.

London, July 13.

I am in general agreement with Mr. Jeans's remarks on the difficulty of obtaining a source of stellar energy more powerful than the Helmholtz contraction. It may be added that there is a conceivable source, which was, I believe, once suggested by Mr. Jeans himself, viz. a gradual annihilation of matter by positive and negative electrons occasionally neutralising one another. This would provide an almost inexhaustible store of energy, but there is the grave objection that it affords no reason why the dense dwarf stars should liberate so much less energy than rarefied stars of the same mass. One would have expected compression to be favourable to the process of cancelling of electrons. The search for an additional store of energy is not at all encouraging; but, on the other hand, there are important arguments against the short time-scale—notably Prof. Strutt's evidence of the age of terrestrial rocks, and the time needed for the tidal evolution of the earth-moon system. I have not felt myself able to combat the arguments on one side any more than on the other; accordingly, in the paper criticised by Mr. Jeans, the question was left entirely open. In the one place where it was necessary to consider the source of stellar energy, I attempted to show that my formula fairly represented both the radio-activity and the contraction hypotheses—having regard to the necessarily approximate character of the investigation.

The opinions in the last paragraph of Mr. Jeans's letter seem much too sweeping. It is desirable to criticise them, because his disbelief in my results is presumably a corollary to his rejection of the possibility of obtaining information from consideration of a stationary or quasi-stationary state. If energy were generated at a fixed rate within the star, the radiation would no doubt have to take place at the same rate; but to bring this about the star must settle into a state of density and temperature which would produce an outward flow of energy at the required rate. We have thus a triangular equation—generation of energy = theoretical emission (depending on the transparency and temperature-distribution) = observed emission (given by the effective temperature). Mr. Jeans assumes that the imposed rate of generation must necessarily be involved in any results that are derived. But we can dispense altogether with the first member, and obtain "new knowledge" from the equation which remains.

July 11.

I am afraid we can scarcely trespass on your space to enter on the detailed discussion which seems necessary in order to arrive at an understanding. In a paper about to appear in the June *Monthly Notices* I have rearranged my analysis in what is, I believe, a more lucid form. If Mr. Jeans finds the result still unsatisfactory, I hope he will renew the attack in another place.

With regard to his final point, I may give a word of explanation. It is true that I find that the total radiation of a giant star depends only on the mass—to my order of approximation. If a different rate of generation of energy, fixed and independent of the density, were imposed, the star could not settle permanently in the giant state. If the supply were too small the star would contract, though more slowly than on the Helmholtz theory, and ultimately attain equilibrium in the dwarf state. The case of too large supply scarcely needs to be considered, since it involves an evolution in the reverse direction from that generally accepted. This may, perhaps, be regarded as additional evidence of the difficulty of obtaining a long time-scale by assuming an unrecognised source of energy.

A. S. Eddington.

Cambridge, July 17.

FORESTS AND RAINFALL.

There are several questions regarding the mutual relations of natural phenomena that appear at first sight so simple that the obvious answers may be received for generations as too clear to require reconsideration. One of these is the influence of forests on rainfall. It seems so natural that if a large area of bare ground is planted with trees which grow into a forest the moisture of the district will be increased by increasing rainfall, diminishing run-off, and, in hot countries, falling temperature, that one scarcely stops to inquire on what evidence the belief is based. Everyone must remember the vivid picture drawn in Marsh's "Man and Nature" of the desolation wrought in Palestine and other Mediterranean lands by desiccation consequent on the destruction of forests and abandonment of cultivation. But in that work, as in most of the writings on this and cognate questions, the motto of the discussion might be *post hoc, ergo propter hoc.*

The problem has been attacked by innumerable writers in Europe and America, and we do not profess to have the mass of heterogeneous literature at our finger-ends. We do, however, retain a general impression of unsatisfactoriness in the methods and results, and the impression is renewed by the latest contribution to the subject, the Indian Forest Bulletin, No. 33. This consists of a "Note on an Inquiry by the Government of India into the Relation between Forests and Atmospheric and Soil Moisture in India," prepared by Mr. M. Hill, Chief Commissioner of Forests of the Central Provinces. Mr. Hill has presented an admirable *précis* of what must be a large mass of official documents, and he appends two excellent memoranda by Dr. Gilbert Walker, the Director-General of Observatories in India. That the good work of Mr. Hill should leave an unsatisfactory impression is not his fault, but his misfortune in having to deal with official reports instead of plain scientific data. The history of the investigation as set out in the bulletin is briefly this:—

In 1906 Lord Morley, then Secretary of State for India, sent to the Viceroy a note from Dr. J. Nisbet, formerly of the Indian Forest Service, pointing out that "the relation of forests towards the mitigation of the severity of famines" had never been adequately considered. Sir William Schlich forwarded with Dr. Nisbet's letter his

opinion that an investigation of the influence of forests on rainfall would be very difficult and unlikely to lead to any definite result. Nevertheless, the Government of India sent out to all the local Governments a request that the subject should be inquired into and all available information collected. In due time the local Governments sent in reports on their own provinces, and these are tersely summarised by Mr. Hill with an admirable neutrality, which nevertheless fails to conceal the fact that the reports differed widely in quality. The general result is stated officially as follows:—

"After a careful examination of the replies received from local Governments, as summarised above, and after consultation with the Director-General of Observatories, the conclusions arrived at by the Government of India were briefly that the influence of forest on rainfall was probably small, but that the denudation of the soil, owing to the destruction of forests, might, as far as India is concerned, be looked upon as an established fact; while as regards the effect of forest preservation on rainfall and the underground water supply, the papers forwarded did not provide sufficient information to justify any change in the principles on which the forest policy of the Government has hitherto been based. It was remarked that these principles were founded mainly on considerations of a directly economic character, connected with the conservation of the grazing resources and forest produce of the country, and that the climatological considerations did not in any way affect these well-established principles."

The Government of India forthwith sent a second series of questions to the local Governments with the view of ascertaining whether experiments might not be instituted in order to obtain fresh data. These dealt with the local differences within and without forest areas in rainfall, soil water level, and height and duration of floods. The local Governments duly prepared and sent in reports, which were considered by the Government of India in consultation with the Board of Scientific Advice, and the final decision, expressed in five paragraphs, may be summarised thus:—(1) Meteorological stations in specially selected positions inside and outside forest areas would probably yield valuable results, and "if it be found possible to initiate inquiries of this nature further action would be taken." (2) Observations on soil water level need not be initiated, as the data would be of little value in showing forest influence. (3) Satisfactory experiments on floods could not easily be undertaken, but the belief that forests are beneficial in this respect is confident and almost universal. (4) No material change in the forest area of any province seemed to be contemplated, but if such changes should be made the Government of India desired that local Governments should make efforts to ascertain the effect of such changes on average rainfall. (5) The system of shifting cultivation, by which large areas of forest are annually destroyed in Native States and elsewhere, should be discouraged.

To our mind the method adopted could produce no better result than it appears to have done. In a scientific problem such as was set forth, the only function of the State seems to us to be to decide that such an inquiry shall be carried out at the public expense, and that every facility for obtaining data shall be given by all the departments of all the Governments concerned, local and central. It should then be handed over to a competent man of science set free from all other duties and supplied with necessary assistants. His report when complete would be authoritative and epoch-making, if not final, and incidentally his own reputation would be made or marred by his handling of the facts. The total expense would probably be no greater, and the labour of many public servants would not be diverted from the work for which they were trained.

Dr. Gilbert Walker's contributions on the relation of forests and rainfall are given as appendices, but are deprived of most of their scientific value by the omission of the tables and diagrams to which constant reference is made. These, of course, have been published in the memoirs of the Indian Meteorological Department. Dr. Walker fully grasps the difficulty of the inquiry. He shows that in India, as elsewhere, the annual rainfall has a tendency to run in spells of excessive and deficient years, and that if this fact is neglected totally false conclusions as to the influence of forest growth or destruction could easily be arrived at. He lays stress also on the short period available for comparisons on account of the very untrustworthy nature of the Indian rainfall statistics in the earlier years of the work of the Meteorological Department.

Dr. Walker considers that, as Blanford pointed out in 1887, "the only satisfactory evidence would be that obtained by comparing the rainfall of a district when well supplied with forests with that of the same district when the trees were very few." In our opinion the comparison should not be that of a district A at the time t with the same district at the time t'; but to compare the relation of district A to a contiguous district B at the time t with the relation of A to B at time t', where A is a district that has undergone a great change as regards forest covering, while B has remained unchanged. The reason for this indirect comparison is, of course, to eliminate the effect of the two periods falling in what Prof. H. H. Turner calls different climatic chapters. Another method would be to determine the relation of the isohyetal lines to the configuration of the land on wooded and treeless districts of similar character. As pointed out in the report on the rainfall in the Geological Survey's "Water Supply Memoirs of Hampshire," the district of the New Forest shows a considerably higher general rainfall than its elevation above sea-level appears to suggest. The subject is both fascinating and important, and the time will no doubt come when increase of accurate observations will enable the vague belief in the beneficial influence of forests on climate to be supported or corrected by definite meteorological evidence.

Hugh Robert Mill.

INDIAN SALTPETRE.[1]

THE brochure before us, issued by the Agricultural Research Institute, Pusa, is the work of the Imperial Agricultural Bacteriologist, and is an interesting and valuable account of an important village industry, which, as is well known, has long been carried on in various districts of India where the factors determining the formation of potassium nitrate, as a soil constituent, are sufficiently favourable. These factors, as summarised by the author, are:—

FIG. 1.—A *nuniah's* factory. From Bulletin No. 68, Agricultural Research Institute, Pusa.

(1) *Nitrifiable organic matter* in suitable proportion in the soil.

(2) *Lime.*

(3) *Water,* not only in sufficient amount for nitrification, but also distributed in the soil in such a way as not to interfere with aeration, and to provide for continual capillary rise to the surface.

(4) *Soil* of such a texture as to allow of continuous upward movement of water from the subsoil to the surface.

(5) *Climate* ensuring a provision of adequate moisture and temperature during part of the year and complete, or nearly complete, absence of rainfall, coupled with low humidity during a sufficiently long period to ensure the capillary rise of subsoil water consequent on rapid surface evaporation.

The methods employed by the *nuniah,* as the operator is termed, for extracting saltpetre from the surface layer, or calcareous portions, of the alluvium have been frequently, although not always accurately, described. Mr. Hutchinson has studied these methods in detail, and his observations throw considerable light upon a procedure which shows little variation throughout India and is based upon the accumulated experience of generations of predecessors.

The supply of saltpetre is almost entirely obtained from the soil in the immediate neighbourhood of human habitations, or of abandoned village sites where nitrogenous organic refuse, consisting largely of excrementitious matters of men and animals, has accumulated.

The surface-soil, or *chhilua,* scraped to the depth of a quarter of an inch, is mixed with an equal quantity of residual earth from previous extractions, known as *bhinjua,* and is placed by treading into a circular filter-bed, or *kuthia,* consisting of a mud wall and floor plastered with clay, and having a bottom layer of bamboos and straw. Water is poured over the earth and, percolating through the loosely compacted soil, is collected in an earthen vessel. The first runnings, or *murhan,* contain most of the nitrate, mixed, of course, with a greater or less quantity of common salt. The solution is concentrated to the crystallising point by boiling in an open pan over a fire of dead bamboo leaves, the ashes of which, being rich in potash, are added to the extracted earth, or

FIG. 2.—Treading the earth into the *kuthia* for extraction. From Bulletin No. 68, Agricultural Research Institute, Pusa.

[1] "Saltpetre: Its Origin and Extraction in India." By C. M. Hutchinson. Bulletin No. 68 of the Agricultural Research Institute, Pusa. (Calcutta: Government Printing Office, 1917.)

bhinjua, to be mixed afterwards with fresh *chhilua*. The *nuniah* seldom or never attempts to separate the mixed salts, as this is forbidden to him by the Salt Department. The crude product is sold, usually through a middleman, to the refiner, who works under Government supervision.

The restrictions of the Indian Salt Department, according to Mr. Hutchinson, undoubtedly hamper the operations of the *nuniah*, who has no inducement to improve his methods so as to turn out a better article. The whole process as at present carried on is essentially wasteful and uneconomical, and might be greatly improved in the absence of official interference. The conditions for the most economical production of saltpetre are well understood by the *nuniah*, and it is to be regretted that he should not be encouraged to make full use of his knowledge and experience.

The Bulletin is an important contribution to an interesting process of manufacture based primarily upon bacteriological agencies. It forms an excellent example of a purely empirical method which has been elaborated by the accumulated experience of centuries, but the rationale of which has only been made clear by modern biological science. In view of the growing scarcity of nitrates and of their increasing importance in the arts, especially in agriculture, it is to be hoped that the Indian Government will neglect no opportunity of conserving and extending an industry which is peculiarly well adapted to Indian conditions.

T. E. THORPE.

THE PROMOTION OF TECHNICAL OPTICS.

THE long-delayed steps which—as announced in NATURE of May 24 (p. 257) and June 14 (p. 317)—have been taken by the Government and the London County Council in concert for establishing the study of optics and of the manufacture of optical appliances upon a proper footing in this country, have given great satisfaction to all who are in a position to appreciate the importance of that measure. That the turning of this new leaf should be among the earliest consequences of the war is a fact both of intrinsic importance and of good augury. The importance of properly organised manufactures of optical glass and of optical instruments has been manifest, and has been pressed upon the Government with great weight of expert authority by the British Science Guild and other bodies for many years past. But in the days before the war, when the optimist was accounted the best as well as the pleasantest of counsellors, it was impossible to secure the attention of our rulers for so modest a proposal as the establishment upon an adequate scale of a school of practical optics.

It is with something more than a sigh of relief that we find ourselves after three years of war able to record this sound decision of the British Government. For, indeed, the matter for congratulation is that there is a British Government still in a position to act. The thought of what range-finders mean to the British Navy, and of how narrowly we escaped being dependent upon the enemy for our supply of these essential instruments, is almost enough to make one shudder even under the wing of a Royal Navy that has swept the sea. It chanced by the happiest of happy accidents that the range-finder which finds the range for our own and all the other navies was of British invention, also that the inventor took the trouble to establish its manufacture in this country as a private enterprise, and, by consequence, that when the war commenced we were in the best possible position to provide both Army and Navy with these important instruments. The Army can, indeed, use alternatives, but the Navy is shut up to the range-finder. Had that been a German monopoly the battle of Jutland might quite conceivably have been the end of British sea-power. Considerations such as these lead us to place on record the sense of immense relief with which we note the new attitude of the Government towards one of the things that matter.

The task before the new department is a large one, and it is beset with many difficulties. That task is chiefly educational, but it is by no means only the education of the student of optics that is here in question. Parliament, and the greater public to which Parliament is responsible, stand in need of education also. The facts just now alluded to concerning the supply of range-finders afford one illustration, and a very striking one, of this necessity. A necessity of a totally different kind is exhibited by the conditions governing the supply of optical glass. This, as is perfectly well known, has been for many years past, in large measure, a monopoly of one Jena glass manufacturer. That arrangement was in a certain sense a good and convenient one. The Jena glasses were excellent in quality—no one could reasonably expect to better them. Specialising in this line, the Jena house was able to produce them in great variety, and did, in fact, list and stock many varieties of optical glass for which the market demand was inconsiderably small.

Competitive manufacture under these conditions could only be wasteful manufacture, and the British glass-makers took what was, from the commercial point of view, the sound position that it was not worth while to spoil a market for a rival which they had no chance of exploiting for their own advantage. Indeed, when it is recognised that the whole world's trade in optical glass would not yield a profit that any successful stockbroker would think considerable, it is easy to understand the reluctance of business men to embark upon a troublesome business with no better prospect than that of largely destroying this modest prosperity and then joining in a scramble for the residue.

How, then, are Parliament and the British nation to be made aware of the technical importance of an industry which is commercially of so small account? That is one of the problems with which the new department is faced.

There is another problem of no less consequence growing out of the same conditions, which will, with equal insistence, demand the attention of Prof. F. G. Cheshire and his colleagues. We have referred to the multiplicity of the varieties of optical glass to which the manufacturers of optical instruments are accustomed. This is, on the face of it, a great point in their favour; but when more narrowly considered it will be found to handicap them appreciably. Let the matter be considered from this point of view. A manufacturer develops by trial and error a very successful optical instrument—a field-glass, for example. He uses a particular combination of optical glasses in its construction. His whole design is built upon the special properties in respect of refraction and dispersion of these particular glasses. So long as he can procure a supply of them upon the open market he does not need to modify any feature of his manufacture. It is a question of repetition merely, and he closely guards the secret of his success. But the time may come when the particular variety of optical glass upon which he relies is no longer available, or not available in the required quantities. What can he do then? Speaking in general terms, he can then do nothing. The practical optician cannot tell him how to substitute staple glasses for the special varieties which he has been accustomed to employ, and hence he insistently demands the accustomed supplies. Thus the lavish variety of optical glasses available to the manufacturing industry has actually tended to restrict growth of output and to reduce adaptability.

Here is one of the practical questions awaiting solution by means of laboratory research. If the optical glass industry is to be well established in this country, it must be an industry which will satisfy the requirements of the manufacturing trade; if it is to be established with a minimum of effort, those requirements must be reduced to the narrowest limits which can suffice. To work out the principle of equivalence between varieties in the combination of glasses, and so to concentrate the glass-maker's labour, so far as is practically possible, upon the production of a few staple varieties, will be a very important object of practically applied research.

These instances may serve to illustrate some of the less generally recognised fields for the activity of the new department. We have not adverted to the more obviously important objects of training teachers, instructing workmen, educating experts, and advising manufacturers. These may be left to speak for themselves, since the limits of our space preclude any adequate exposition of them in the present article.

With one word of congratulation we may close, and that upon the choice of a director for the new undertaking. Prof. Cheshire brings to his task a mind not only well stored with the technical knowledge of his subject, but also instructed by a wide experience of its practical side. We have every confidence that in his hands the machinery of the new department at the Imperial College of Science and Technology will be directed to practically important ends, and while reserving our congratulation of him personally, upon the sound principle which forbids premature compliments to the warrior who is girding on his armour, we congratulate the authorities who, by their choice of him for the important post which he is about to fill, have shown how large practical considerations, such as those to which we have here adverted, bulk in their view. That, at least, is as it should be.

THE AEROPLANE BOMBER'S PROBLEM.

THE problem which the bomber on board an aeroplane has to solve is more difficult than the corresponding problem of the bomber on board an airship, since the aeroplane must move with respect to the air to support itself, while the airship may be brought to rest over the object to be bombed. The bomb on release has a horizontal speed equal to that of the aeroplane, and if the air were at rest and offered no resistance to the motion of the bomb through it, the path of the bomb would be a parabola with its axis vertical and its vertex at the point of release. The resistance of the air prolongs the time of fall of the bomb to an extent which depends on its size and weight, and may be 50 per cent. if the overall density of the bomb is small. Any horizontal motion of the air causes a drift of the bomb down the wind which depends on the speeds of the various layers of air through which it passes during its fall, and on the resistance the air offers to the sideways motion of the bomb through it.

The dynamical equations which express the above facts have not yet been rigidly solved, but they are so closely related to the equations for high-angle fire in gunnery that the approximate methods of Col. Siacci or of Capt. Ingalls, or the recently published graphical method of Prof. Dalby, are all applicable, when the weight, altitude, and initial horizontal speed of the bomb, the mean speed and direction of the wind, and the resistances to downward and sideways motion of the bomb through the air are known. The altitude is shown on the aneroid of the aeroplane. The speeds of the aeroplane with respect to the ground and of the wind at the aeroplane are found by passing over an object with and against the wind respectively, and noting how long it takes the aeroplane to pass from the vertically overhead position to one, say, 10° or 20° up or down the wind from it. From the speed of the wind at the aeroplane thus found an estimate of the mean speed of the wind in the layers of air through which the bomb has to pass must be made, and this estimate can only be a rough one. With these data the bomber consults tables or curves previously prepared for the bombs to be used, which give him the bearing from the machine of the spot at which a bomb released at the moment should fall if the conditions remain unchanged. Thus the bombing aeroplane requires to be equipped with apparatus for measuring horizontal and vertical angles and times.

The description in *La Nature* for June 16 of the equipment of one of the large German bombing aeroplanes made by the Gotha Wagonenfabrik and captured by the French in February shows that at that date these planes were only intended to drop bombs when moving with or against the wind, and not athwart it. The bomber sits in front of the pilot and is provided with a telescope about a metre long with a small magnification and a wide field of view. It is fixed in gimbals near his feet, and can be kept vertical by him with the help of a circular level, an image of the air-bubble of which is projected into the eyepiece. Below the objective an achromatic prism is placed with its refracting edge perpendicular to the axis of the telescope. By means of a graduated disc close to the eyepiece the prism can be rotated about a line perpendicular to the axis of the telescope, so that the line of sight of the telescope continues beneath the prism at any required angle up to about 30° with the axis of the telescope.

A stop-watch with its dial close to the eyepiece enables the preliminary speed observations to be readily made. The prism can then be clamped at the proper angle for the conditions found, and on looking down the telescope the bomber sees at each instant in the middle of the image of the air bubble and in the centre of his field of view the spot on which a bomb released at that instant would drop. If the aeroplane is moving directly towards a point in the air from which a given object can be bombed, the image of that object will move towards the centre of the field along a fore-and-aft line in the field. If the aeroplane is not moving directly towards the object, the observer has to rotate the telescope about a vertical axis to bring the object into the fore-and-aft line. The rotation of the instrument is recorded on a dial before the pilot, who alters the direction of flight until the observer can bring the telescope back to its normal position and the dial in front of the pilot shows no error of direction.

The instrument is made by the firm of Goerz, and there is no difficulty in modifying it so that the restriction of its use to flights with or against the wind no longer holds. Whether this has been found advisable may be doubted, in view of the uncertainty which always exists as to the character of the air movements between the aeroplane and the ground.

C. H. LEES.

NOTES.

WITH reference to the paragraph which appeared in a recent issue of NATURE regarding the Société de Chimie Industrielle, further particulars as to the scope of the new society appeared in *L'Echo du Commerce* for July 20. The object of the society will be to promote the science of chemistry as applied to industry. Local provincial branches will be formed which, while being self-governing, will keep in touch with the parent society at Paris. The society will institute research work with the view of assisting manufacturers and agriculturists. An institute and library are in contemplation which will contain a complete collection of French and foreign periodicals devoted to industrial chemistry, and the society hopes to arrange for meetings, exhibitions, etc., to stimulate activity. A review—the first number of which is expected to be published shortly—will keep manufacturers posted in the latest developments at home and abroad, describe inventions and processes, and, generally, fill a want that has been long felt in France. The first council of the society contains many names prominent in the scientific and industrial world.

FOR some days the firing in Flanders has been unusually heavy, culminating in the Allied attack on Tuesday, July 31. On Saturday last, July 28, according to a message from Amsterdam, the thunder of the guns reached a greater pitch of intensity than ever experienced previously. A similar remark is made by the Dover correspondent of the *Times* (July 30). The firing heard in that town was almost continuous throughout the night of July 28–29, and was particularly heavy about midnight and just before daybreak. A correspondent of the *Daily Telegraph* states that, on the afternoon of July 25, "while yet the hum of the London traffic was dominant, the sullen boom of the guns in Flanders was heard in many districts in South London. As the evening advanced the sound became a low growl, unmistakable, and practically continuous." The sound of the heavy firing on Tuesday was also heard distinctly in London.

THE current *Quarterly Review* contains an article by Dr. C. Davison on his investigation of the sound-waves of the East London explosion of January 19 last. As stated in NATURE for February 1 (p. 438), the sound-area consists of two detached portions. The inner sound-area is distorted in two main directions. Towards the east-south-east it reaches Canterbury, 48 miles, and to the north-west Wellingborough, 66½ miles; but to the north-east and south the boundary is only 19 or 20 miles from the source. The outer sound-area reaches from near Nottingham, across the south of Lincolnshire and Norfolk, to, and no doubt beyond, the east coast of the latter county. The most distant place at which the sound was certainly heard is Stow, near Lincoln, 128 miles. The width of the silent zone varies from 28 miles at the western and higher end to 48 miles at the eastern end. Speaking generally, the inner sound-area was one of single reports and the outer area one of multiple reports—two, three, and sometimes four reports being heard in quick succession. The existence of inaudible air-waves was manifested by the shaking of windows and the disturbance of pheasants, and the arrival of these waves was not, as a rule, coincident with that of the sound-waves. Within 15 or 20 miles of the source the air-waves passed after the sound was heard, at greater distances usually before. The air-waves were not, however, confined to the sound-areas, for their effects were noticed at sixteen places within the silent zone, nine of them being in the narrow western portion. The sound was heard at Ipswich, which lies a few miles from the northern boundary of the silent zone, and possibly also at Uppingham and Lilford, near the western end. It is inferred that both the inaudible air-waves and the sound-waves crossed the silent zone at moderate heights above the ground, but that the air-waves followed a lower path than the sound-waves.

EARLY in July Mr. Erik Andersson, of Uppsala, again led to Spitsbergen a geological expedition, which included Messrs. Adam Reuterskiöld, Sven Ydén, and Karl Samuelsson. The main object was to continue the investigation of the Trias and to collect saurians and fishes. The occurrence of phosphorite at Cape

Thordsen was to be investigated, as well as the extent of the coal beds at Pyramid Hill and Bünsowland. Investigations in the Devonian rocks are to be continued and their vertebrate fossils collected. A large expedition of miners and mining engineers also left Sweden about midsummer to exploit the Coal Measures of Spitsbergen, and was accompanied by Dr. Anteus as geologist.

THE Committee of the Privy Council for Scientific and Industrial Research, on the recommendation of the Advisory Council and at the request of the Home Office, has sanctioned the appointment of a committee with the following terms of reference:—"To inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations, and defects of the several types of apparatus, what improvements in them are possible, whether it is advisable that the types used in mines should be standardised, and to collect evidence bearing on these points." The members of the committee are:—Mr. W. Walker, Acting Chief Inspector of Mines under the Home Office (chairman), Dr. J. S. Haldane, and Dr. H. Briggs. Mr. A. Richardson has been appointed secretary to the committee, and Dr. H. Briggs has been constituted director of the inquiry.

AT the representative meeting of the British Medical Association held on July 26, the council reported that the only possible method of placing the health administration of the country on a sound basis was by the creation of a Ministry of Health. The recommendations of the council were as follows:—That a Ministry of Health should be created to take over from existing Government Departments such duties as are concerned with the health of the community, and to deal with those duties only; that the administrative functions of the Ministry should be carried out by a Board presided over by a Minister of Cabinet rank; that the country be divided into suitable administrative areas under local administrative health centres consisting of representatives (*a*) of the rating authorities; (*b*) of the education authorities; (*c*) of the persons contributing to a scheme of health insurance (including employers of labour); (*d*) the medical profession; (*e*) public hospitals; (*f*) dentists; (*g*) pharmacists; and (*h*) nurses; that the principal medical officers of each centre should be two, of equal status, one representing the clinical side (chief clinical officer) and the other the preventive side of medicine (medical officer of health); that for each area, hospitals, clinics, or treatment centres should be recognised or established at which persons entitled to treatment under the public scheme should be able to obtain institutional, consultative, or specialist services on the recommendation of their medical attendant. The meeting approved of the appointment of a Ministry of Health by a large majority.

NEWS of the American Crocker Land expedition is published in *Science* for June 29 from information supplied by Dr. H. J. Hunt, surgeon of the expedition, who arrived in New York on June 20 from Greenland *viâ* Copenhagen. The expedition was at Etah in northern Greenland when Dr. Hunt left it last December. He reports that it had enough provisions to last until about August 1 this year, after which it must depend upon walrus and caribou. However, the relief steamer *Danmark* was at North Star Bay, a sledge journey of about 150 miles from Etah, so there should be no fear of the expedition starving. The *Danmark*, when Dr. Hunt left her, was frozen in and short of coal, but had ample stores. She will probably get free from the ice this summer, but in order to ensure the safety of the explorers, the *Neptune* has been chartered and sent north under Capt. R. A. Bartlett. Dr. Hunt, in his journey to the Danish settlements of Greenland, had to sledge 1400 miles between December 18, 1916, and April 16 of this year. Part of the way he was accompanied by the Danish explorer, Knud Rasmussen. Eskimo were with him throughout the journey. The expedition, which is under the leadership of Mr. D. B. Macmillan, reports a considerable amount of work, especially geological. Seismological observations have been taken at Etah.

THE Trematode, *Schistosoma* (*Bilharzia*) *mansoni*, occurs frequently in man in Venezuela; adult specimens of this parasite were found by Dr. Risquez (1916) during post-mortem examinations in the School of Medicine at Caracas in 20 per cent. of the cases. Drs. Iturbe and González have recently published, from the laboratory of the former, an account (8 pp., two plates) of experiments made with the view of finding the intermediate host of this parasite in the neighbourhood of Caracas. The four common fresh-water "snails" of that area are two species of Planorbis, an Ampullaria, and a Physa, and the first three can be infected experimentally by adding to the water in which they are living the ciliated larvæ, or miracidia, of *S. mansoni*, but it is evident that *Planorbis guadelupensis* is the only species which naturally serves as the intermediate host of *S. mansoni*. The development of the miracidium in this Planorbis, and the formation of rediæ (described as having a widely open mouth and a rudimentary gut) and cercariæ, are in accord with the account by Miyairi and Suzuki of the corresponding stages of *S. japonicum*. The cercariæ of *S. mansoni*, after escaping from the infected Planorbis, can live in water for at least twenty-four hours. Experiments on white rats and on young rabbits and dogs showed that they acquire the parasite by the entry of cercariæ by the mouth or through the skin, though the actual penetration of the skin by the cercariæ was not observed. Naturally infected *Planorbis guadelupensis* were found in six of the seven localities examined near Caracas, and of 400 specimens from one of the canals 120 proved to be infected.

Two interesting and timely contributions on experimental work at the South-Eastern Agricultural College, Wye, furnish the main features of the June issue of the *Journal of the Board of Agriculture*. Prof. E. S. Salmon summarises the results of several years' experiments in potato-spraying with Bordeaux and Burgundy mixtures at the college in an article which, by the results quoted and the accompanying photographs, is calculated to remove the last doubt as to the economic soundness of the practice. In each of the five years the sprayed crops produced, not only an increase in the yield of tubers ranging from one ton to five tons per acre above the yield of the unsprayed crops, but the proportion of "ware" and of sound tubers was also markedly superior. The results further indicate that spraying is only effective when applied before the appearance of the "blight," and that the benefits of an early spraying can be substantially increased by a second spraying. Wet spraying proved superior to dry spraying in the one comparison made.

DR. J. VARGAS EYRE and Mr. S. T. Parkinson contribute to the June issue of the *Journal of the Board of Agriculture* a report on an inquiry carried out at Wye into the possibility of conserving surplus plums by drying. The investigations cover the preliminary treatment of the fruit to facilitate drying, the relative merits and efficiency of hot-air and vacuum drying, and the final treatment of the dried product to render it more attractive. The best results and most speedy drying were obtained with the vacuum machine and at a temperature of 70° to 80° C. The most effective

preliminary treatment was to expose the plums to the vapour of chloroform, whereby the rate of drying was appreciably reduced and a somewhat superior product obtained. A substantial improvement in the quality of the product was obtained by heating the dried plums in a limited quantity of steam in a closed vessel for a few hours. Further articles of interest in the same issue of the *Journal* are an account, by Mr. G. P. Berry, of studies of pollination problems carried on in cherry orchards in Kent, and a summary by Miss W. Brenchley of observations made at Rothamsted on the viability of buried weed seeds.

MR. S. HIBINO, in vol. xxxix. of the Journal of the College of Science, Tokio, has made some observations on the effect of "ringing" the stem of *Cornus controversa*. In these experiments either the cortex alone, or the cortex together with the outer layer of wood, was removed. One of the effects of ringing is to cause a development of anthocyan in the leaves, not only above, but also below, the seat of injury. The leaves also, especially if the wood is injured, gradually lose their colour and fall earlier than normal ones. The water content of the leaves of a "ringed" tree gradually decreases, the uppermost leaves being the first to be affected. The leaves above the position of ringing contain more starch and show a much greater diastase activity and a larger content of reducing sugar, also an excess of oxydase and peroxydase. The buds of ringed trees unfold their leaves much later the next spring than do those of normal trees; on the other hand, the ringed plants flower earlier and more freely than normal ones, and produce a bigger crop of fruit. Immediately below the seat of injury there is a marked development of adventitious shoots.

IN the July issue of *Man* Sir D. Prain endeavours to decide the geographical diffusion of kava and betel. The former, an infusion of *Piper methysticum*, is said by Drake del Castillo to occur spontaneously and as a cultivated plant in the Society and Marquesas Islands. But it has to be kept in mind that such a plant may be spontaneous without being necessarily native, and we have no record save that of Drake as to its having been found in a wild state. It is not wild in the Sandwich Islands, and it seems to be only a cultivated plant in Fiji, while it is said not to be known in those islands which are inhabited by Papuans. The case of betel (*Piper betel*) is not so uncertain. It clearly came to India from the Malay Peninsula, but it is doubtful if it is a true native of Java. It is said to be wild in Celebes and probably in the Moluccas—an interesting point, because these islands lie east of the "Wallace Line," and from the botanical point of view all east of the "Wallace Line" is Papuasia, though it is more usual to consider Celebes and the Moluccas as integral portions of Malaysia. The result of the inquiry is that betel is of Papuasian origin, and that its use spread thence westward to Malaya proper, and from there to India; while kava is of extra-Papuasian origin, though where that origin is to be sought is far from certain. All that can be said with safety is that the probabilities point to Polynesia.

IN the *Meteorological Office Circular*, No. 13, attention is directed to the official substitution of the names "Richmond" and "Cahirciveen" for Kew and Valencia Observatories respectively. The auxiliary sunshine station which has been called Richmond in the Monthly Weather Report will be known as Richmond Hill. It is of interest to note that Valencia Observatory was originally on Valencia Island, but was moved to Cahirciveen in 1891.

THE *Jahrbuch des Norwegischen Meteorologischen Instituts* for 1916 has been published. This useful volume contains detailed observations at the observatories of Christiania and Aas, a summary of the year's observations at twelve stations, and the yearly and monthly means of all the stations in Norway. In addition there is an appendix giving the detailed pressure, temperature, and other readings at Green Harbour, Spitsbergen (lat. 78° 2′ N., long. 14° 14′ E.), from September, 1915, to June, 1916.

RECENT monthly and annual results of magnetical, meteorological, and seismological observations, made at the Royal Alfred Observatory, Mauritius, under the directorship of A. Walter, give valuable data for the several elements of specified branches of work. Observations are brought into line with the change of units now generally adopted in this and other European countries, except that for meteorological results the temperatures are given in degrees Centigrade, and to obtain temperatures in Absolute scale 273° have to be added. This method of giving temperature results has much in its favour, and little exception can be found provided that the method adopted is always clearly stated. The magnetical and meteorological observations in the monthly results are given for each hour, and the range in the various elements affords material of value for the inquirer. A table of monthly rainfall is given for about 150 stations in the island. As 1915 closes the eighth quinquennial period of observations, the annual report gives the monthly and yearly normals of the meteorological elements for forty years. Modern units are employed. Attention is directed to a marked periodicity with an interval of about eighteen and a quarter years between successive maxima in certain elements, and a more detailed discussion of the forty years' records is promised. More information on methods employed would enhance the value of results and would prevent possible misunderstanding; for instance, the table of results for forty years bears no evidence that the atmospheric pressure observations are uncorrected for height above sea-level, 181 ft., or that all other corrections have been applied, but the system generally adopted can be culled from parts of the monthly publications.

AT the meeting of the conference of delegates of the Corresponding Societies of the British Association held in London on July 5 Mr. T. Sheppard was asked to open a discussion on the metric system, as showing the need for some such scheme in the interests of the advancement of science. Mr. Sheppard gave an account of the various specimens of money scales and weights in use from early Greek and Roman to Victorian times. By far the finest collection of these money scales in the country, consisting of more than 200 varieties of boxes, now in the Hull Museum, was brought together by Mr. Sheppard, with the help of Mr. J. F. Musham, of Selby. The lecturer dealt with the absurdities of the system of weights and measures, illustrated, as regards money weights, by a series of specimens from the Hull collection. A long discussion ensued, which was continued on the following day. Mr. Sheppard's paper will be printed *in extenso* in the annual report of the British Association.

THE Canadian Department of Mines has issued the annual report on the mineral production of Canada for the year 1915, and it is satisfactory to note that, in spite of the adverse conditions necessarily created by the war, the mineral industry is in a flourishing condition. Although the value of the production has not reached the high record of 1913, it nevertheless shows an increase of 6·4 per cent. over that of 1914,

this increase being, however, by no means uniform all round. There have been considerable decreases in the production of such building materials as clay, lime, sand, etc., whilst the quantities of all the metals produced, with the sole exception of silver, show marked increases; the increase in the output of pig-iron produced from Canadian ores amounts to nearly 63 per cent., and in the output of copper to 33 per cent. Of non-metallic minerals, coal is still by far the most important, its value being returned as 23·42 per cent. of the total value of all Canadian mineral products; the output, practically 13¼ million (short) tons, shows a trifling falling off from the output in 1914; this decrease appears to be entirely due to shortage of labour. In this connection, attention may be directed to Bulletin No. 14, recently issued by the department, on "The Coalfields and Coal Industry of Eastern Canada," which gives an excellent account—historical, geological, technical, and economic—of the coalfields of the maritime provinces. The important part that these coalfields are playing in the industrial development of Canada is well brought out in this useful monograph.

IN the Christiania *Forhand*, 1907, Prof. C. Størmer gave a theoretical discussion of the motion of an electron round a centre of force from which a magnetic and also an electrostatic field originated, a problem which has also been treated by Principal Hicks in the Proc. Royal Soc. (vol. xci., A). In a publication recently received, "Sur un Problème relatif au mouvement des Corpuscules Electriques dans l'espace cosmique" (Christiania: Videnskabssel Rabets Skrifter, 1917), Prof. Størmer gives a series of numerical calculations of orbits about a magneto-electric centre. Obviously orbits of given energy must be confined to surfaces of revolution about the magnetic axis. Diagrams and photographs of these surfaces are given in profusion, the latter being obtained by photographing the rapid rotation of a whitened wire bent to the shape of the generating curve. The title of the memoir is somewhat misleading, for it is purely mathematical, and there is no discussion of the bearing of the results obtained upon the problem of the motion of electrons in cosmic space.

THE paper on dielectric losses in insulating materials read before the American Institute of Electrical Engineers in March by Mr. C. E. Skinner, of the research department of the Westinghouse Company, is published in full in the June number of the Journal of the Franklin Institute. The material is tested either in sheets or when built into the transformer or alternator in which it is used. It is subjected to an alternating voltage up to 50 kilovolts at a frequency of 25 to 60. The power absorbed by the insulator is measured by the quadrant electrometer wattmeter method, the difference of potential between the needle and quadrants of the electrometer depending on the voltage applied to the specimen, while the difference of potential between the pairs of quadrants is proportional to the current taken by the specimen. The curves for the various materials given in the paper show that the power absorbed by the dielectric is equal to the product of a constant into the nth power of the voltage applied. The value of n is not given, but from the curves it appears for a given material to be nearly independent of the temperature and of the frequency of the alternations, while the constant depends on both these quantities.

A PAPER on "The Action of Chemical and Physical Agents on some Types of Scientific Glassware," by J. D. Cauwood, S. English, and W. E. S. Turner, was read at the meeting of the Society of Glass Technology held in Manchester on July 25. Soon after the outbreak of war, chiefly owing to the insistent demands of the Sheffield steel works' chemists, steps were taken to promote the manufacture of high-grade chemical ware in this country. How well the glass manufacturers have risen to the occasion is shown by the results given in the paper, for it appears that glasses have been produced as good as, if not better, in some respects, than, the best German glasses. The method employed in the research had been to subject Jena glass, five new British resistance glasses, and a few chemical glasses made in Allied and neutral countries to a series of fourteen definite tests. In every test applied the British glasses compared most favourably with Jena glass, in some of the tests even surpassing it.

PROF. J. SEBELIEN, of the Norwegian Agricultural High School of Aas, has recently (*Tidsskr. for Kemi, Farmaci og Terapi*, Nos. 5–8, 1917) published the results of a comparative examination of chemical glass and porcelain ware and of filter paper from various sources. It would appear that owing to the war the former German monopoly is also threatened in neutral laboratories. The Swedish glass of the Limmared works compares favourably with Jena glass as regards resistance to chemical reagents, particularly to potassium hydroxide, which dissolves considerable quantities of silica and of boric acid from Jena glass. The laboratory porcelain of the Royal Porcelain Works at Worcester was found to be quite as good as that of the Berlin factory; both these are superior to the Haldenwanger and the Bayeux products. The author confirms the findings of the National Physical Laboratory with regard to the Worcester porcelain, which is slightly less resistant to heat changes than that manufactured in Berlin, and slightly more resistant to chemical reagents. Munktell's Swedish filter paper was found superior to others tried as regards low ash content and uniformity, some of the German kinds showing considerable variations. The Whatman papers compare favourably with the German makes, the excellence of which is by no means so exclusive as the makers would suggest. With respect to chemicals, Norway appears to have been almost absolutely dependent on imports from Germany, but some substances are now being manufactured. The author points out that the war has taught Great Britain to free herself from Germany in the matter of pure laboratory reagents, and expects that after the war these will be obtainable in his country at the same prices as the German products.

Engineering for July 27 contains an account, with drawings, of the wooden ships which are being built in the United States in order to compensate for the war losses in the mercantile marine without making great demands on steel, which is required in ever-increasing quantities for war munitions. The specifications for the ships illustrated were prepared by Mr. Theodore Ferris, the naval architect of the United States Government Shipping Board. The vessels are of the single-deck type, 281 ft. 6 in. long, 46 ft. beam, and 26 ft. moulded depth. The total estimated dead-weight is 3500 (long) tons; the sea speed, loaded, will be 10 knots, and two 3-in. guns will be carried. Four caulked watertight wooden bulkheads extend to the upper deck, forming two cargo holds and the machinery space. The propelling machinery may consist of one triple-expansion engine, or twin-screw reciprocating engines, or geared turbines, subject to the approval of the owners. The timber used in the construction of the vessels may be either dense southern yellow pine or Douglas fir, with stern-post, rudder-post, etc., of white oak. Wood knees will be of hackmatack or oak. Joiner sheathing and decks will be of cypress.

Messrs. W. Heffer and Sons, Ltd., Cambridge, have published a useful catalogue (No. 166) of scientific books, periodicals, and publications of scientific societies, which will be sent upon written application. It is conveniently classified under the headings of agriculture and husbandry; horses and horsemanship; botany; chemistry; geology, mineralogy, and palæontology; zoology, biology, and Nature-study; physiology, anatomy, and medicine (sub-section, dentistry); mathematics, physics, and engineering; and astronomy. It includes a selection from the library of Dr. L. C. Miall, and works on conchology and malacology, mainly from the library of the late Prof. H. M. Gwatkin.

Sotheran's "Price Current of Literature" (H. Sotheran and Co., 140 Strand, W.C.2), No. 769, has just appeared under the appropriate title of "The History of Civilisation," seeing that it deals with works on anthropology, folk-lore, archæology, and sociology. It is a valuable catalogue, classified under the headings of general works, early and primitive man, and the dawn of civilisation—(*a*) Oriental and (*b*) Occidental—and contains particulars of the library of the late Sir Laurence Gomme.

A new and revised edition of vol. i. of Dr. G. McCall Theal's "History and Ethnography of Africa South of the Zambesi" is announced for immediate publication by Messrs. George Allen and Unwin, Ltd. The work covers the period from the settlement of the Portuguese at Sofala in September, 1505, to the conquest of Cape Colony by the British in September, 1795.

A catalogue (No. 376) of books on architecture, art, archæology, etc., has just been issued by Mr. F. Edwards, 83 High Street, Marylebone, W.1.

OUR ASTRONOMICAL COLUMN.

Comet 1916*b* (Wolf).—The following is a continuation of Messrs. Crawfurd and Alter's ephemeris, of this comet for Greenwich midnight, as given in Lick Obs. Bulletin, No. 295:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
Aug. 1	23 29 14	+22 10 13	0·0088	2·68
3	30 48	21 44 21	0·0065	
5	32 15	21 16 23	0·0043	2·68
7	33 33	20 46 20	0·0023	
9	34 44	20 14 14	0·0005	2·67
11	35 48	19 40 6	9·9989	
13	36 44	19 4 0	9·9976	2·65
15	37 32	18 25 58	9·9965	
17	38 14	17 46 5	9·9957	2·61
19	38 49	17 4 26	9·9953	
21	39 18	16 21 8	9·9951	2·55
23	39 41	15 36 17	9·9953	
25	39 58	14 50 2	9·9959	2·48
27	40 10	14 2 31	9·9968	
29	40 18	13 13 55	9·9981	2·39
31	40 22	12 24 23	9·9998	

The unit of brightness is that on April 21. An ephemeris by Dr. Kobold (*Ast. Nach.*, No. 4892) gives the magnitude of the comet during early August as 10·0. The comet will be in opposition on September 17.

Variable Proper Motion of δ Cassiopeiæ.—An investigation of the Pulkowa observations of the zenith star δ Cassiopeiæ has been made by L. Courvoisier in relation to Guthnick's discovery that this star is an eclipsing variable having a period of about 2·1 years (*Ast. Nach.*, 4891). It results from the discussion that there is a variation in the proper motion arising from the binary character of the star, and that the amplitude in declination of the two-yearly oscillation amounts to $0{\cdot}04'' \pm 0{\cdot}01''$. The correction to the assumed value for the aberration constant, $20{\cdot}47''$, is $+0{\cdot}01''$, and the deduced parallax of the star is $+0{\cdot}11''$.

The Needs of Astronomy.—The Astronomy Committee of the National Research Council of the United States has issued an interesting report on the most pressing needs of astronomy. The best immediate use of a fund for astronomical research is considered to be the provision of increased facilities for observations in the southern hemisphere, and the erection of large reflectors in both hemispheres for the extension of nearly every research to very faint stars. The provision of more assistants to aid in carrying on extensive routine observations would also secure a relatively great increase in the output of existing institutions. The twenty examples of work of a more or less routine character which are specified include determinations of the positions of all stars of ninth magnitude and brighter, proper motions of all stars down to magnitude 7·5, and parallaxes of all stars down to magnitude 6 and of specially selected fainter stars. Photometric observations of all stars to ninth magnitude, determinations of the radial velocities of all stars of magnitude 6 and brighter, and the more systematic observation of double and variable stars also form part of the suggested programme. One important outcome of such routine work would be the publication of a catalogue of all stars down to magnitude 6·5, giving for each the approximate position, proper motion, radial velocity, magnitude, spectrum, colour index, etc., which, it is suggested, should be brought up to date every three years. The possible services that astronomers can render in the war are under consideration.

THE TRANSLITERATION OF RUSSIAN.

The transliteration of Oriental and other characters into Roman script naturally varies with the genius of the language into which the transliteration is made. The diversity of the resulting metamorphoses is bewildering, and any attempt to evolve cosmos out of this chaos should be welcome. As regards Russian names, with which we are immediately concerned, such an attempt has been made, for bibliographical purposes, by the Russians themselves, under the auspices of no less an authority than the Academy of Sciences of Petrograd.

To give some idea of the importance of this system of transliteration, the use of which has not yet extended beyond scientific circles, a brief relation of the circumstances which led to its inception may not be out of place. The beginning of this century witnessed the birth of a great scientific bibliography, published by the Royal Society of London under the title of "The International Catalogue of Scientific Literature." It is, in effect, a continuation of the Royal Society's "Catalogue of Scientific Papers," which is now in course of completion up to the close of last century. It is carried on, as its name implies, by international co-operation, and it is supported by almost the whole of the civilised world. One of its distinctive features being that it records the work of scientific investigators in their original language, the alphabetical arrangement of authors' names necessitated the adoption of a system of transliteration for each language which does not employ Roman script. The Petrograd Academy of Sciences thereupon applied itself to the problem of Russian names, and referred the matter to a special committee consisting of H. G. Zaleman (chairman), F. E. Korš, E. I. Lamanskij, N. A. Menšutkin, and A. A. Šachmatov. The result of its

deliberations was the elaboration of a system of which the underlying principle can be explained in a very few words. It is based on the phonetic value of the Bohemian alphabet. Bohemian being a Slav language which employs Roman script, the materials for a consistent and intelligible scheme of transliteration lie ready to hand. This alphabet with its diacritic signs enables us in most cases to represent one Russian letter by one Roman letter, and this in itself constitutes an improvement on the systems previously in vogue, notably on the Continent of Europe, most of which are vitiated by imperfect phonetic apprehension.

The following is a summary of the report of the committee:—

"The basis of the transcription is the phonetic value of Roman letters in the Bohemian alphabet:—

а б в г д ж з і, и й к л м н о п р с т у ф
a b v g d ž z i, j k l m n o p r s t u f

х ц ч ш щ ы ѣ э ѳ ѵ
ch c č š šč y ě e f i

я, ю, at the beginning of a syllable, and consequently also after ъ, ь, which are omitted, are written ja, ju, but, after consonants with which they form one syllable, ĭa, ĭu. In like manner е and ѣ after ь, ъ are written je, jĕ, but after consonants simply e, ĕ. At the beginning of proper names the simple e should be used, *e.g.* Egorov, not Jegorov. After ь, i should be replaced by ji.

"The letter ъ is not transcribed, but ь at the end of a word and before consonants is written ĭ, *e.g.* дать = datĭ, конь = konĭ, большой = bolĭšoj. The accented е pronounced jo is represented, as in Russian, by ё, but in the case of proper names the diæresis should not be used unless the author himself uses it, *e.g.* Чернышевъ = Černyšev, Ёвшинъ = Ėvšin, Берёзинъ = Berezin."

To attempt by any system of spelling to reproduce the well-nigh infinite inflexions of the human voice is to attempt the impossible, but there is one important point in the above scheme which, whether by inadvertence or design, seems to have been passed over. No mention is made of the genitive termination го, where г invariably has the sound of v. Добраго were better transcribed Dobravo than Dobrago.

It may be objected that such a system is not suited to English-speaking countries, that the introduction of the Bohemian alphabet further complicates matters. The reply is that it was devised, not with special reference to English or for the purposes of teaching, but primarily to meet the needs of international bibliography. It should be mentioned that it has been adopted by the Royal Society in its "Catalogue of Scientific Papers" and by "Minerva: Jahrbuch der gelehrten Welt," published at Strassburg, and that it is obligatory for all work in connection with the International Catalogue of Scientific Literature. It seems opportune at the present moment to direct attention to the existence of a system of transliteration which it is hoped will in time supersede all others for bibliographical purposes, and which bears the imprimatur of the Russian authorities, who earnestly desire its extended adoption.

EDWARD FOORD.

SCIENCE IN EDUCATION AND ADMINISTRATION.

THE subjoined Memorandum has been approved by the Senate of the University of London and transmitted to the Treasury, the Board of Education, the Civil Service Commission, the Committee on Science in the Educational System of Great Britain appointed by the Government, and the Royal Society:—

1. Primary and secondary education should be directed towards making active and useful citizens, and should include the development of mind and character and instruction in the fundamental branches of knowledge.

Literary, linguistic, mathematical, and scientific studies should be regarded as fundamental branches of knowledge, and each pupil should receive some instruction in all these branches. In the case of pupils who pursue their education beyond the age of sixteen, these subjects should as a rule be continued, and public and secondary schools should not undertake specialised training in professional subjects.

Opportunities for learning Latin and Greek should be given in one or more schools in every educational area.

While it is not desirable that it should be compulsory on all pupils, some form of artistic and manual training is to be regarded as of very high importance.

2. The teaching of natural science (including physics and chemistry) should be compulsory in all secondary schools, both boys' and girls' schools.

3. All secondary schools retaining pupils beyond the age of sixteen should be capable of providing instruction in the science subjects of the entrance examinations of the universities up to the standard required for these examinations.

4. Special technical day schools, in accordance with local needs, should be established in all industrial centres for boys and girls between thirteen and sixteen years of age who wish to enter the technical (including engineering, chemical, and artistic) industries at the age of sixteen.

5. In order to secure for science teaching the position to which it is entitled, and which for the benefit of the nation it ought to occupy, the schemes under which the great public schools are administered should in each case contain provisions to the effect:—

(*a*) That the governing body shall include a substantial number of representatives of the learned and scientific societies, and

(*b*) That members of the governing body shall not hold office for life.

Without such provisions, it is probable that men distinguished by mathematical or scientific attainments will continue to be at a disadvantage in applying for appointment to headmasterships of public schools.

Greek should not be a compulsory subject for entrance scholarships to these schools; and adequate facilities (including equipment) for learning science should be available for, and accessible to, all their pupils.

6. The number of branches in which a first university degree can be taken should not be unduly multiplied, but students who have taken a first degree in science should be encouraged by the institution of higher [M.Sc.] degrees, especially in technical branches, to specialise in particular branches of science, or in their applications to industry. The preparation for such degrees should include some training in the methods of research.

7. The present arrangement for the selection of first division clerks in the Civil Service should be modified so that on every occasion an adequate proportion of those appointed must have had mathematical or scientific training.

8. In all selections for the higher administrative posts for the Government Departments the work of which is of a scientific or technical character the official selected ought to have received such a scientific training as will fit him to understand the character of the work for the organisation of which he will be responsible.

RADIO-ACTIVE HALOS.[1]

THIS discourse is concerned with certain very minute objects of the rocks—so minute as to be visible only with the aid of the microscope—known to petrologists by the cumbersome name of "pleochroic halos." Although we shall be occupied mainly in considering quite recent additions to our knowledge of halos, yet, in view of the fact that many of this audience will probably hear of them now for the first time, it is necessary to begin with some elementary remarks.

The halos of the rocks have been known since the application of the microscope to rock study; but until recently their origin and nature were quite unknown. Nor could it have been otherwise, for they find their explanation in the facts of radio-active science only—a science the origin of which dates back but little before the beginning of the present century. The student of the rocks in past times seems to have regarded these objects with but little more than passing interest. Had he paid more attention to them a case replete with extraordinary mystery could have been made out, and one which at the time must have remained absolutely inexplicable. The lack of attention to the detail displayed by halos, and the failure of the earlier observers to notice the mathematical regularity of their dimensions, well illustrate how advance in one domain of science may influence our recognition of facts in another.

The most familiar type of halo consists simply of a darkened border surrounding some minute mineral particle within the rock. The formation of the coloured border indicates some alteration in the medium in which it is formed, and this alteration is evidently conditioned by the presence of the central mineral. If the latter is very small and about equally developed in all directions, the halo takes on the form of a sphere having at its centre the mineral which has originated it. In a section of the medium containing the halo this sphere appears as a coloured disc; but as we find the same appearance, no matter in what direction we section the halo, its spherical form is beyond doubt.

Certain facts respecting the formation of halos have for long been available. Only quite a few substances can originate a halo. Of these the minerals zircon and orthite are the commonest, and the first much more so than the second. Again, only in certain media surrounding such minerals can a halo be developed. Of such media the several varieties of brown mica are the most abundant and the most valuable. It would appear that all media sensitive to the formation of halos contain iron as a constituent.

While these facts have long been available, the next I have to mention is a recently discovered one. All those minerals which give rise to halos are found, when examined in large crystals, to contain radio-active substances.

Now, such substances, we well know, are continually radiating. They give out various sorts of rays. This leads us to suspect that the halo may, in fact, be generated in some way by these radiations. There are three sorts of radiations—the α, β, and γ rays. The last two cannot possibly be responsible. They are far too penetrating to account for these microscopic effects. The α rays can alone be concerned.

Before pursuing further our inquiry in this direction, let us examine the nature of the halo itself. It is not merely a stain or lodgment of colouring matter in the medium. If we apply optical examination with polarised light to a halo in brown mica we find that the peculiar optical properties of the mica, which are, of course, referable to the orderly arrangement prevailing among its molecules, exist within the halo just as elsewhere. In fact, we might say they are accentuated. The remarkable absorption of the ray polarised in the plane of cleavage of the mica is more complete in the halo. We occasionally see a halo which extends across the edges of two distinct flakes of mica. If the light is polarised and the plane of polarisation is in the plane of cleavage of one of the flakes, and is inclined to the cleavage of the other flake, that part of the halo which is contained in the first crystal of mica is intensely black. In the other crystal of mica the halo is much lighter in colour. Plainly the effect upon the mica, however exerted, has been such as to increase the absorption of a ray vibrating in the plane of cleavage. The crystallographic structure has not been disturbed. If iron is not a constituent of the medium no visible effect is produced.

Of the last statement we sometimes find very beautiful evidence in the case of halos which originate from a nucleus located outside the sensitive medium, but within a certain distance of it. Fig. 1 will explain. The originating crystal is in quartz, a substance which never contains halos. There is no iron in its constitution. But the halo-forming influence extends to a neighbouring crystal of mica. This influence, which develops an outlying part of the halo-sphere in the mica, must have traversed the quartz. It has left no record therein. If the halo was something of the nature of a stain diffused outwards from the central substance—as some of the earlier observers maintained—the absence of the colouring material from the quartz is not easily explained. But if the halo is—as we have hinted—due to radiations proceeding from the zircon—radiations which only affect certain unstable atoms—the appearance at once finds simple explanation. The quartz is not sensitive to the rays; the mica is.

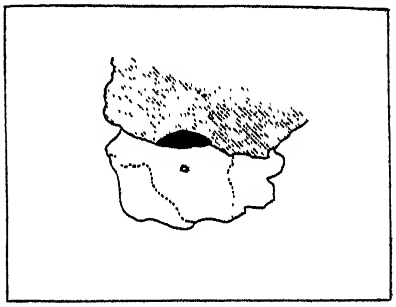

FIG. 1.—Nucleus of halo located outside a sensitive medium.

But the primary evidence for the radio-active origin of the halo is to be found in its dimensions. The fully developed halo has been found in two sizes. One of these shows a radial dimension of 0·0333 mm.; the other scales, radially, 0·0408 mm. There are two primary radio-active elements, as everyone knows—uranium and thorium. If the central or originating substance contains uranium it will of necessity contain all the eight α-ray-emitting substances which the uranium-radium series embraces. Similarly, if the central substance contains thorium, there are seven α-ray-producing substances which must be present. Now each of these various radiating substances emits α rays which possess a certain specific velocity of emission, and, consequently, a specific power of penetration. The most penetrating ray of the uranium series is that of radium-C. In air this ray will travel 6·94 cm. before it comes to rest. The most penetrating ray of the thorium series is that of thorium-C_1. This will penetrate 8·60 cm. before coming to rest. A very few rays travel further, but this does not affect the matter. Now Bragg has shown how we may calculate the range in any medium if we know its chemical

[1] Discourse delivered at the Royal Institution on Friday, May 11, by Prof. J. Joly, F.R.S.

composition and its density. We can, accordingly, calculate what the range of these extreme rays should be in mica. When we do so we get exactly the dimensions of the two sorts of halo. We shall presently see that even this evidence is but a part of the case for the radio-active origin of the halo.

Uranium halos—that is to say, those in which uranium is the parent radio-active mineral contained in the central zircon—are common. Such are not generally capable of accurate measurement. But in clear, flawless mica, viewed on the plane of cleavage, halos of extraordinary delicacy and sharpness of outline are sometimes met with. Again, the halo is often completely blackened up. Such halos may be described as "over-exposed." As in the case of different exposures in photography, we find every gradation in the amount of detail according to the amount of action which has taken place.

We must remember that the causes which have given rise to the halo are highly complex. We may represent the several rays concerned as generating a number of concentric spheres of ionisation, the radii of which are in correct relative proportion to the penetration of the several rays.

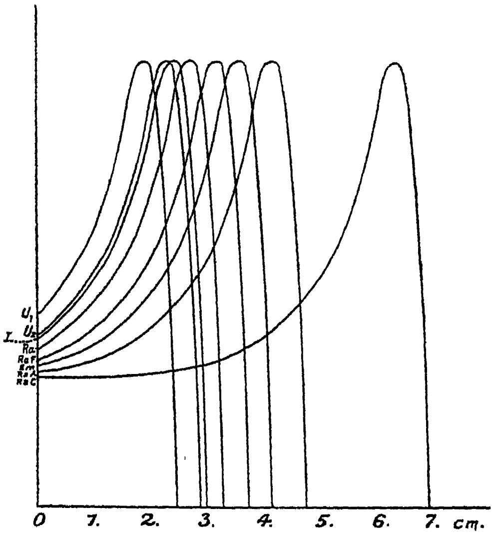

FIG. 2.—The eight ionisation curves forming the uranium halo.

But this fails to represent the full complexity of the conditions. Each ray behaves in a very remarkable way. To enter into this matter here is impossible. We must be content to recall that the effects of the α ray in ionising the medium in which it travels varies along its path. It appears certain that its influence on the mica, or in whatever mineral it generates the halo, depends upon its power of ionising the atoms with which it comes into effective contact. Now the number of ions created along its path remains at first fairly constant, but rapidly increases towards the close of its career, just before its effects become naught. Bragg's well-known curve shows the manner in which the ionising effects in air of a single α particle vary along its course. This curve applies to all rays, however short the range; we must simply curtail the length of the earlier part of the curve when the range is short.

Now, if we assume that the distribution of effects of the ray along its course in the mica are much the same as they are in a gas, we see that along any radius of the halo-sphere we must admit the effects of eight rays, each ray penetrating a distance depending on its initial velocity and acting upon the mica in the manner represented by the Bragg curve of ionisation. Fig. 2 shows you this state of affairs. We assume that by adding the ordinates at any point we can find the integral or total ionisation due to all eight rays so far as they produce an effect at that point. The curve of total ionisation follows (Fig. 3).

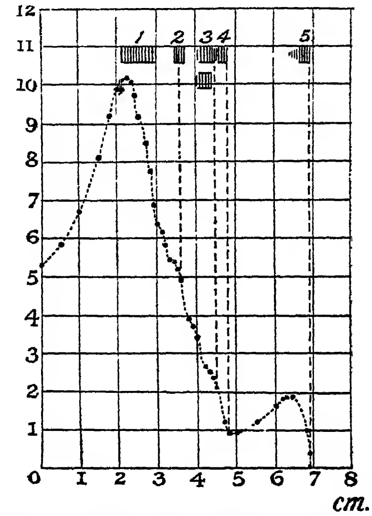

FIG. 3.—Integral curve of ionisation for uranium halo.

But even this curve does not represent the entire conditions. It may be said to represent the effects along a radius of the sphere which has been traversed by all the eight rays. But the radii of the sphere are, of course, diverging from the centre. The net effects which generate the halo must therefore grow weaker outwards. When we make the requisite allowance for this, nearly all the detail of the last curve disappears, and we are given as the theoretical structure of the halo a steadily diminishing density outwards until we reach such a distance from the centre that RaC_1 or ThC_1—as the case may be—begins to exert its separate effects. These effects then appear as a penumbra-like border surrounding the inner darkening. I now show you, for the case of the uranium halo, this final curve of development (Fig. 4). Halos exhibiting a character in fair conformity with the curve are not uncommon.

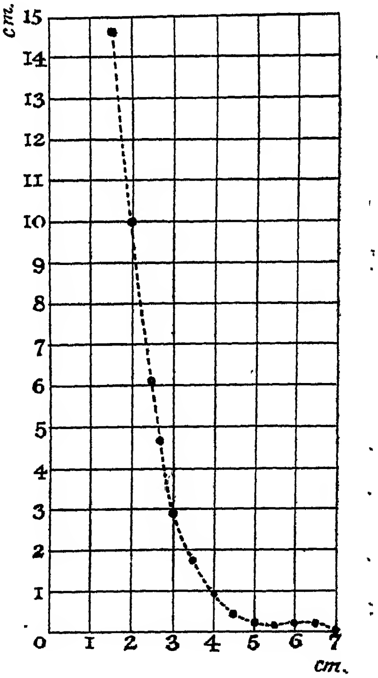

FIG. 4.—The integral curve modified by spreading of the rays.

But, as I have said above, less exposed halos show considerable detail. We find, in fact, that separate and individual rings are developed in the growing halo. Plainly this should not be if the development was in accordance with the last curve. Under favourable conditions such recalcitrant halos are met with. It is quite evident that they are out of agreement with the theoretical curve. The growth has not been one of uniform darkening outwards with the final addition of the penumbra due to RaC_1. And, most contradictory of all, we see that the effects of RaC_1 show themselves

while the inner rings are still in an early stage of development.

But if now we return to the first curve of development—that one which takes no account of the spreading of the rays—we find a scheme of development which closely coincides with the actual details as observed in the process of halo-growth.

First, we have a solitary ring, or shell, of ionisation surrounding the nucleus. In its earlier stages it is not easy to photograph. It plainly corresponds with the first conspicuous maximum of the ionisation curve (Fig. 3). This I call the first ring. The rays from U_1 and U_2 are chiefly responsible for it. This first ring, accentuated and darkened within, is often found in a succeeding stage of development along with the earliest impression of the outermost ring of all, that due to RaC_1. Next, outside the first ring, appears a very delicate and seldom-found ring, which I name the second ring. It corresponds, apparently, with the first notable excrescence on the downward slope of the curve. By the time this ring has developed, the inner region of the halo has considerably blackened up. Nor have I found this second ring without the presence of a third ring surrounding it, and evidently referable to the next excrescence on the curve. At this stage, too, we find that RaC_1 has still further registered its effects.

The stage which succeeds shows the inner detail out to the third ring obliterated in the accumulating ionisation. There is now, therefore, a central pupil surrounded by the third ring and outside all the border due to RaC_1. A yet more advanced stage finds the third ring also swallowed up in the inner darkening. This is the stage which in itself is deceptive as to the true course of development of the halo.

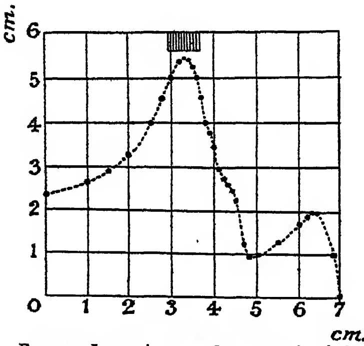

FIG. 5.—Integral curve for emanation halo showing position of first ring.

The successive features of the developing uranium halo have been indicated above the curve of integral ionisation. The features numbered 1, 2, and 3 are the first, second, and third rings; 4 shows the limiting position of the radius of the pupil when all is blackened up within; 5 is the ring due to RaC_1.

An interesting modification of the uranium halo is found in the mica of County Carlow. The α rays of U_1 and U_2, of ionium and of radium, have apparently played no part in its genesis. The parent substance responsible for the halo is the short-lived emanation of radium. This element, and those derived from it, alone take part in its formation. Consequently, only four out of the eight α-ray-expelling substances are concerned in its architecture. As these include the furthest reaching ray—that of RaC_1—the outside dimension of the halo is the same as that of the complete uranium halo.

When we plot the integral ionisation curve of this halo we get an initiating ring of appreciably larger radius than is associated with the beginning of the uranium halo (Fig. 5). And it is by this larger initiating ring that the new halo is identified. In later stages it is difficult to differentiate it from the uranium halo.

The mode of origin of the emanation halo is interesting. All through the mica in which these halos are found there is evidence that radio-active solutions or gases were at one time transported along minute channels or cracks. These channels are bordered with radio-active darkening, showing just such an appearance as Rutherford got in the walls of a capillary tube containing condensed emanation of radium. Again, the darkening around the conduit in the mica may often possess the radial dimension of the first ring. Along such conduits we find every now and again a refracting particle which acts as the nucleus of an emanation halo. Apparently the particle has served to condense the emanation or to absorb it, and thus becomes the centre of radiation for α rays given out by substances which are derived from the emanation by further disintegration. Consequently, emanation halos are found developed along such cracks or conduits, often presenting the appearance of beads upon a string.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. H. ROGER has been elected to succeed the late Prof. Landouzy as dean of the Paris Faculty of Medicine.

A CHAIR of tropical pathology has been established in the University of Lima, Peru, and Dr. J. Arce has been appointed professor.

BY the will of the late Sir Charles Holcroft a bequest of 5000*l.* is made to the University of Birmingham, to establish a Charles Holcroft Research Fund.

THE Museums' Association proposes to hold a conference at a town in the midland counties in October next to discuss, among other subjects, local war museums and the Board of Education and museums. Mr. Fisher, President of the Board of Education, has pointed out the necessity for promoting the advancement and application of art to industry in a more direct and extensive manner after the war, when industrial development will demand all possible aid. This is work that equally concerns many museums. The reorganisation of education, both elementary and secondary, foreshadowed by Mr. Fisher, also calls for the active co-operation of museums, and is the opportunity for closer co-ordination of their work with the schools. Both subjects to be considered concern museum committees, as well as curators, and members of museum committees are, therefore, specially invited to attend the proposed conference.

FOLLOWING the lead of other educational bodies, the Association of Assistant-masters in Secondary Schools has issued a statement of the educational policy of its members. The aim of education, it is said, should be to secure the healthy, physical, mental, and moral development of the child, so that he will take his place in the community as an efficient citizen. The national system of education should provide, the policy urges, for the compulsory full-time education of every child up to the age of sixteen years at least. Continued secondary education, from the age of sixteen to eighteen, should be preparatory to university education or to business or professional life. No child who has shown capacity to profit by a course of secondary education should be refused admission to the schools, even if the child has to be fed and clothed at the public expense to enable him to attend. No boy should be admitted to a university under the age of eighteen. Science should be included in the curriculum of pupils under fourteen years of age, and it is laid down that every candidate taking the first school examination

at about sixteen years of age must have completed an approved course in science. These are a few only of the demands of the assistant-masters, but they will serve to show how far behind the ideals of this body of schoolmasters is the present system of education in this country.

Two courses of twelve lectures each on "The Designing and Computing of Telescope Systems" will be delivered at the Imperial College of Science, South Kensington, by Prof A. E. Conrady, during this month and next, commencing on August 13. The lectures will be given in connection with the newly formed department of technical optics at the college, under the direction of Prof. F. J. Cheshire. The importance of optical designing and computing, together with evidence of its neglect in the past by English opticians, has been one great lesson of the war. Serious delays in the production of optical munitions have arisen from the inability of manufacturers to obtain the necessary constructional data for the systems required. Many manufacturers are still under the impression that satisfactory designs cannot be obtained without the making up of a succession of samples in the workshop, in each one of which an attempt is made to correct the errors found by the testing of the sample which immediately preceded it. Experience has shown, however, that the necessary constructional data, such as curves, diameters, thicknesses, and separations for given glasses, can be obtained by calculation alone, and that so satisfactorily that a manufacturer is justified in putting in hand an order for a large number of systems without the making up and testing of a single sample. In first-class designing the trial-and-error work is done on paper only, whereas by the older and less efficient methods the theoretical trial-and-error work of the computer must be checked and tested from time to time by practical trial-and-error work on a number of workshop constructions. The manufacturer of the future who is not in a position to enlist as required the services of a competent designer—that is, one capable of producing satisfactory designs by pen-and-paper work only—will, therefore, be at a great disadvantage as compared with competitors who have such assistance available. The courses of lectures at the Imperial College have been decided upon for the immediate purpose of assisting manufacturers in the production of optical munitions of war, but at the same time they will give to those manufacturers an opportunity of furthering the technical education of such of their employees as are, or will be, responsible for the scientific direction of their work in matters of optical design, and thus ensure, so far as possible, favourable conditions for entering into that keen commercial struggle which must inevitably follow the attainment of peace. The lectures will appeal also to those who, having the necessary mathematical knowledge, are anxious to learn the theory and practice of optical designing. Intending students should apply to the Director, Technical Optics Department, Imperial College, South Kensington, London, S.W.7.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 20.—Dr. Alfred Harker, president, in the chair.—Dr. A. **Holmes**: The Pre-Cambrian and associated rocks of the district of Mozambique. Beyond the coastal and volcanic beds of Mozambique (described in a previous contribution, Abs. Proc. Geol. Soc., 1916, No. 994, p. 72) the country assumes the form of a gently undulating plateau, gradually rising towards the west and diversified by innumerable *inselberg* peaks and abruptly rising clusters of hills. The dominant rock throughout is a grey biotite-gneiss. Interfoliated with this are occasional lenticular masses of hornblende-gneiss and amphibolite, and within these smaller bands of crystalline limestone are sometimes preserved. Schists—referable to arenaceous sediments—are found only near the coast, where they are interbanded with gneisses; and, as the latter are mainly of igneous origin, they are thought to be intrusive into, and therefore younger than, the schists. The succession of rocks in eight of the better-known districts is described, and a general classification based on the details is given. The correlations of certain groups of rocks with the Lower and Middle Pre-Cambrian of other regions are based on the determination of lead-uranium ratios of zircons derived from the gneisses and granulitic granites respectively, the zircons having been obtained by crushing and panning the rocks in the field. The gneisses give a ratio of 0·21, comparable with a ratio of 0·24 obtained for Canadian zircons of Laurentian age. The granulitic granites give ratios of 0·14 to 0·17, comparable with those of radio-active minerals of late Archæan—that is, late Middle Pre-Cambrian—age in Scandinavia (Moss 0·12 to 0·15, Arendal 0·16 to 0·18, and Ytterby 0·15 to 0·17), Canada (Villeneuve, Quebec, 0·17), and India (Singar 0·14). The rocks are described in detail, with tables giving the quantitative mineral composition and the specific gravities and radium contents.—L. **Richardson**: The inferior oolite and contiguous deposits of the Crewkerne district (Somerset). A detailed description is given of the inferior oolite of the Crewkerne district.

EDINBURGH.

Royal Society, July 9.—Dr. J. Horne, president, in the chair.—Prof. A. **Robinson**: The origin, rupture, and closure of ovarian follicles. In the ferrets and polecats there are two distinct growth periods: (1) a period of relatively slow growth extending over several weeks; (2) a period of rapid growth lasting from twenty to forty-eight hours. During the first period the cavity of the follicle forms, and is filled as it forms, with a viscid tenacious "primary" fluid, which gradually becomes membranous at its periphery, where it is intimately connected with the follicular epithelium. During the second period a much less viscid "secondary" fluid is quickly formed amidst the epithelium of the ovarian cumulus, which is simultaneously disintegrated and dispersed. Thereafter the secondary fluid forces its way, between the membranous periphery of the primary fluid and the follicular epithelium, to the apex of the follicle. Under increasing pressure the follicle ruptures, and the ovum, with its corona of follicular epithelium, the disintegrated cumulus epithelium, the whole of the secondary fluid, and part of the primary fluid are evacuated and pass into the oviduct. The remainder of the primary fluid fills the remnant of the cavity of the follicle and plugs the orifice through which the contents escaped. So soon as the orifice is plugged distension of the follicle recommences, and fluid again accumulates in its interior. Simultaneously the orifice contracts, the plug shrinks, and in from thirty to forty-eight hours the orifice is completely closed, and the follicle again fully distended. The formation of the secondary fluid depends upon insemination. The follicular epithelium becomes vascularised before the rupture takes place, but there is no effusion of blood when this occurs.—Prof. D. **Waterston**: Development of the heart in man. Reconstructions of the hearts of embryos at different stages of development were exhibited and their indications discussed. They showed clearly the profound changes which take place in the structure of the heart, changes which occur as the heart is carrying on its functions. Another point dealt with was the mechanism of the subdivision of the

heart into its various chambers and the formation of the valves of the heart.—Prof. E. T. **Whittaker**: Compound determinants. A general method of reducing compound determinants to simple determinants.—Prof. W. H. **Metzler**: Vanishing aggregates. This paper gave a generalisation of a theorem due to Sir Thomas Muir.—Dr. J. M. **Thompson**: A further contribution to our knowledge of *Platyzoma microphyllum*, R. Br. An analysis was given of the spore numbers in the various sporangial types, and it was shown that the small and large sporangia and spores already described for Platyzoma are well-defined generic features. The typical spore number for a small sporangium is 32, while that for a large sporangium is 16. The facts available, though insufficient to show the true nature of the various spore types, strengthen rather than weaken a belief in the heterosporous nature of Platyzoma. The plant is then probably an up-grade fern in which segregation of the microsporangia and megasporangia is not yet complete, and in which the megaspores do not declare their female character until they are shed. Should, however, the sporangial development and spore germination prove the plant to be homosporous, its anomalous structure and unique position among living Pteridophytes will be accentuated.

PARIS.

Academy of Sciences, July 2.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: The limiting equilibrium of a sandy mass.—A. **Gautier** and P. **Clausmann**: A new method of destruction of tissues for the estimation of arsenic and other mineral matter. The method in current use requires large quantities of nitric and sulphuric acids of a high degree of purity; the new method now proposed is free from this disadvantage. By drying and heating to 300° C. the material to be examined is brought into a condition in which it can be powdered, and this is mixed with 2 to 3 per cent. of its weight of quicklime and a little water added. The mixture is burnt off in the muffle at a low red-heat. The ash is powdered, taken up with water, and a few drops of sulphuric acid added, filtered and evaporated until fumes of acid are given off. After dilution this can be transferred to the Marsh apparatus and the arsenic estimated in the usual manner. The whole examination can be carried through in a day, as against three days' work by the older method. The results of tests proving the accuracy of the process are given.—G. **Gouy**: The effects of molecular shock on the spectra of gases.—M. **Akimoff**: Fourier-Bessel transcendentals with several variables.—Ed. **Chauvenet**: The acid sulphate of zirconyl.—F. **Dienert** and F. **Wandenbulke**: The estimation of free chlorine in solutions of hypochlorites. The addition of a large excess of ammonium salt to the hypochlorite solution, followed by potassium iodide, prevents the formation of iodate and allows the direct estimation of chlorine in alkaline solution by arsenious acid.—(The late) A. **Cochain**: A new manner of understanding the deformation of the earth's crust.—R. **Dubois**: Remarks on the recent researches of M. Newton Harvey on biophotogenesis.—Mme. Marie **Phisalix** and F. **Caius**: The poisonous properties of the parotidian secretion in species of snakes belonging to the Boideæ and the Uropeltideæ.—W. **Kopaczewski**: Researches on the serum of *Muraena Helena*. The physiological action of the serum. The normal serum possesses very marked hæmolytic properties; these are lost after heating to 56° C. for fifteen minutes. The bacteriolytic properties are not so marked. The serum was devoid of agglutinating or precipitating properties.—F. **Mesnil** and E. **Roubaud**: The sensibility of the chimpanzee to human paludism.—H. **Stassano**: The sterilisation of liquids in thin layers by heat.

BOOKS RECEIVED.

The Public School System in Relation to the Coming Conflict for National Supremacy. By V. S. Bryant. Pp. xviii+78. (London: Longmans and Co.) 1s. 6d. net.

Report of the Commissioner of Education for the Year ended June 30, 1916. 2 vols. (Washington: Government Printing Office.)

Industry, Science, and Education. By Principal E. H. Griffiths. Pp. 70. (Cardiff: Roberts and Co.) 1s.

Index of Spectra. By Dr. W. M. Watts. Appendix x. (London: W. Wesley and Son.)

Memoirs of the Geological Survey. Scotland. The Economic Geology of the Central Coalfield of Scotland. Area viii., East Kilbride and Quarter. By R. G. Carruthers and C. H. Durham. Pp. iv+55+map and table of vertical sections. (Edinburgh: H.M.S.O.) 2s. net.

The Annual of the British School at Athens. No. xxi. Sessions 1914–1915; 1915–1916. Pp. viii+238+plates xv. (London: Macmillan and Co., Ltd.) 21s. net.

Correction Tables for Thermodynamic Efficiency. Calculated by C. H. Naylor. Pp. 59. (London: E. Arnold.) 5s. net.

Heat Drop Tables: Absolute Pressure. Calculated by H. Moss, from the Formulæ and Steam Tables of Prof. H. L. Callendar. Pp. 63. (London: E. Arnold.) 5s. net.

Continuity, or From Electrons to Infinity. By Dr. P. S. G. Dubash. Pp. 60. (Blackburn: G. Toulmin and Sons, Ltd.) 1s. 6d.

Chemistry in the Service of Man. By Prof. A. Findlay. Second edition. Pp. xv+272. (London: Longmans and Co.) 6s. net.

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THURSDAY, AUGUST 9, 1917.

CHARTS AND PROJECTIONS.

Charts: Their Use and Meaning. By Dr. G. Herbert Fowler. Pp. iv + 47 + charts viii. (London: J. D. Potter, 1916.) Price 4s.

DR. FOWLER states in his preface that whilst the use and meaning of maps have often been described, no book appears to have been written describing charts, but anyone who can read a map can readily read a chart also, for charts are merely maps of harbours and coast and ocean areas. At any rate, it scarcely appears necessary to describe parallels of latitude and meridians of longitude, or to give a long description in chap. iii. of conventional signs which are graphically depicted on a sheet published by the Admiralty, namely, Sheet X. ii., price 2s.

Charts published by the Admiralty are designed for navigational purposes, and may generally be classed under three headings: (1) charts for ocean voyages out of sight of land; (2) charts for navigating along a coast; and (3) charts or plans for entering harbours or taking vessels through narrow channels. The general charts are mostly on the Mercatorial projection, whilst the plans of harbours, etc., are on the gnomonic projection.

The idea of the Mercatorial projection is that if the earth be enclosed in a cylinder of a diameter equal to the earth's diameter, and all lines from the earth's centre be produced until they reach the cylinder, this will give a representation of the earth where all the parallels of latitude are equal in area, but their distance from the equator will be equal to the tangent, and the scale on that parallel equal to the secant of the latitude. This has certain advantages for navigational purposes, as all the meridians are parallel and the route taken by a vessel is shown as a straight line; but the disadvantage is that the route thus shown is not the shortest distance that can be followed by a vessel in sailing across the ocean; and although in the days of sailing vessels, when the progress was slow, this was not of much consequence, in these days, when vessels may steam 500 miles or more in the day, special lines have to be drawn to show the route to be followed, and the course by compass has to be constantly changed.

Although it is impossible to show on a flat surface a large area of a sphere or spheroid with perfect accuracy, a considerable area may be so shown by the gnomonic projection. The idea of the gnomonic projection is to place a flat board or surface against the sphere touching at its centre the central spot of the area to be shown, the board being at right-angles to a line drawn from the centre of the sphere to this central spot, *i.e.* tangential to the sphere's surface. Now on a sheet of paper 8 ft. square, which is as large as can be conveniently used for plotting charts, if a scale of 1 in. to the nautical mile be adopted, an area of 7000 square miles can be shown, when the error of the longest distance that can be measured on the chart would not exceed 2/100 of an inch—that is, about 100 ft. This error is practically of no consequence for navigational purposes.

On the gnomonic projection, if the chart be graduated, all the meridians are inclined and the parallels are curved, and it may be considered as a correct representation. The Mercatorial projection is greatly distorted.

Dr. Fowler gives representations of some charts, and in the preface to his book recommends the reader to study first his last chapter on the use of instruments, and it is certainly true that without a knowledge of mathematical instruments it is useless to study this work; but to readers unacquainted with the use of mathematical instruments it is better to study some good work which treats of the subject, such as that compiled by Mr. J. F. Heather, rather than the account given by Dr. Fowler.

Dr. Fowler's explanation of the reason why, owing to the flattening of the earth at the poles, the miles of latitude increase in length from the equator to the pole is not because a sector of 10° with a large radius is greater than a sector of the same number of degrees with a small radius—this is true whether the globe is a sphere or spheroid—the real reason being that with a spheroid the radii which enclose a sector are of unequal length, the one nearest the pole being shorter than the one nearest the equator. Thus if the radius nearest the pole be, say, 5 miles shorter than the one nearest the equator and the length of the arc 60 minutes, we have practically a right-angle triangle with a base of 60 miles and a perpendicular of 5 miles to find the hypotenuse.

The representations of the Admiralty charts given by Dr. Fowler require to be cut out of the book and spread separately on a drawing board, or flat table, before they can be utilised. Chart i. is not on the Mercatorial projection, as stated on p. 6, but on a gnomonic projection, though the difference on a chart of the scale of 4 in. to the nautical mile between the two projections is inappreciable for such a small area.

Dr. Fowler gives directions as to how to graduate chart iv., on which there is neither scale nor position, but states on pp. 7 and 8, though not very clearly, that the natural scale of the chart is 1/12,100 and the position of the Longships lighthouse lat. 50° 4′ 4·1″ N., long. 5° 44′ 43·9″ W. By the natural scale he shows that by referring to Carrington's tables he finds the chart scale to be almost exactly 6 in. to the nautical mile, and then draws a line 6 in. long and divides it into tenths, etc., and having done this gets a longitude scale by a graphic method instead of taking out the scale of longitude from Carrington's tables, whence he got his latitude scale. He does not appear to be aware of the great value of the sector in dividing lines or taking off proportional distances from it. The directions on p. 8 would be much shorter if the sector was understood and used.

B B

It would greatly facilitate the work of a student if a reference were given in the margin to the chart, which should be consulted in all cases where directions are given for plotting courses or bearings, etc.

On chart vi. the isobar between 28·78 and 29·09 should be 28·94, and not 28·24.

Dr. Fowler omits to notice the great advantage of the "knot." It combines a measure of a time with a measure of distance—one knot signifying one nautical mile per hour, ten knots ten nautical miles per hour.

MENTAL ASPECT OF SOUND.

The Psychology of Sound. By Dr. H. J. Watt. Pp. vii+241. (Cambridge: At the University Press, 1917.) Price 10s. 6d. net.

THIS volume is written by a psychologist of repute, who is a lecturer on psychology in the University of Glasgow. It is one of the most important presentations of the sense of hearing since the time of Helmholtz. It is true that Dr. Watt discusses hearing more from the psychological than from the physiological point of view; he is less interested in the physiological mechanism than in the mental experiences associated with hearing. Still, the author is familiar with physiological theories regarding hearing and the cochlea. In the eighth chapter he gives an excellent critical account of all the physiological theories from Helmholtz onwards, and discards them more or less in favour of a theory of his own, which he thinks reconciles psychological and physiological data better than any other.

His theory, briefly stated, is that the basilar membrane does not act as a resonance apparatus, but when a sound wave enters the cochlea from the stapes there are variations of pressure at points of the basilar membrane—positive and negative pressures—positive when the pressure is increased by the stapes, negative when the pressure is diminished and backward; and the negative pressure "dissipates itself in all directions." It is not easy to understand the illustrative diagram on p. 164. There remains the doubt whether an accurate analysis can be made of motions in a space of such small dimensions as the *scala intermedia*. Nor is it easy to see what is gained over the resonance theory by the resolution of motions into positive and negative pressures.

Limits of space forbid giving a detailed account of many of the author's views. Pitch is primarily a variation of *quality*, or it includes that within it. Physiologists have used the term "quality" with a different meaning, and they prefer a "quantitative classification" of pitch. Pitch, in our view, depends on the number of pressures on the auditory mechanism, or the duration of each pressure, and this fits in with a theory of resonance. Again, the word "mass," as applied to tones, is liable to lead to confusion. "Bi-tonal mass" is a term difficult to understand; the meaning of tone or blending of tones is clearer if we think of the fusion of two or more waves to form one. There is an important chapter on the analysis of tonal sequences, and interesting explanations are given of experiences on this subject. The author discusses melody and the formation of scales. "Intensity is not, as is often supposed, the direct basis of auditory localisations, but only the indirect basis. It is required to provide a means whereby the predominance of one order over others may be attained." There must be a predominant order. This is difficult to understand. Surely it is easier to regard intensity as the result of greater or less stimulation? The author gives an admirable summary of his conclusions. His most important point is that the cochlea has few of the characters of an analytic apparatus, and thus much of the resonance theory is discounted.

This is undoubtedly a book on psychology, but it will indirectly be of much service to the physiologist. The physiologist has to explain how the ear works, and he confines himself to the mechanism. The psychologist adds to this, mainly by introspective methods, an attempt to explain the experiences associated with hearing, and the feelings that arise from these. Psychology and physiology are distinct departments of science, and each must be investigated by its own methods. The danger is to allow one province to encroach on the other. One has to remember also that when we listen to a tone, or a combination of tones, as in music, we have to do not only with the cochlea, but with neural processes in the brain and elsewhere. The psychologist may be able to frame theories that will explain these experiences, but neither he nor the physiologist can tell us much of the neural phenomena. We do not accuse Dr. Watt of mysticism. He is too learned a psychologist to fall into this error. An extensive bibliography, enumerating no fewer than 159 separate works, shows how he has drunk deeply at the well-springs of both psychology and physiology. Not a little in this book will awaken reflection. There is an excellent index.

J. G. M.

OUR BOOKSHELF.

Cotton Spinning. By W. Scott Taggart. Vol. iii. Fourth edition. Pp. xxviii+462. (London: Macmillan and Co., Ltd., 1916.) Price 10s. net.

MR. SCOTT TAGGART'S treatise has become a standard book of reference on cotton spinning, and deservedly so; the illustrations are excellent, the descriptions of the various pieces of mechanism are clear and adequate, and the scheme of the work is based upon the regular sequence of the movements dealt with.

Vol. iii. is devoted to mule and ring spinning, to winding, doubling, reeling, gassing, bundling, mill planning, and humidity. It also contains a chapter on "Useful Information." In most cases attention has been given to the relative importance of the several sections into which the treatise is divided, but more care might, with

advantage, have been given to this aspect of the subject. For example, four times as much space is devoted to reeling, and nearly as much to bundling, as to gassing. This is not commensurate with the relative importance of the operations.

It is when the author turns his attention from machinery to the material to be treated and after its treatment that lack of clearness, loose statements, over-statements, and errors are found. The matter on p. 17 relating to the diameter of yarns may be cited as an example of these defects. Mr. Taggart's book, as a whole, is so good that it is unfortunate that those parts which deal with cotton and its behaviour during and after spinning have not been revised.

How to Know the Ferns. By S. L. Bastin. Pp. viii+136. (London: Methuen and Co., Ltd., 1917.) Price 1*s.* 6*d.* net.

THIS book contains descriptions of the British ferns and their allies, prefaced by an account of ferns in general and an outline of their classification. The chapter on life-histories is well up to date, as is also that on fossil ferns, a group usually ignored in books of this kind. The species are described without unnecessary technicalities and on a uniform plan; first comes an explanation of the name, then a general account of the structure of the plant, followed by an indication of its habitat and, in most cases, hints on its cultivation. These descriptions, written in narrative form, give a good account of the general appearance and distinctive characters of the various species, but their use would have been greatly increased by adding a short key to genera to the synopsis of families on pp. 8–12. The last two chapters deal with collecting, preserving, and cultivating ferns.

Amongst the fern-allies there is a description of *Azolla caroliniana*, an American water plant, which has been naturalised and has spread with great rapidity during recent years in this country, but no reference is made to *A. filiculoides*, which is also naturalised in Britain.

There are thirty-three illustrations taken from photographs, which have not been reproduced very successfully. This book is a trustworthy and up-to-date addition to the many popular accounts of British ferns. C. H. W.

Chemistry in the Service of Man. By Prof. Alex. Findlay. Second edition. Pp. xvi+272. (London: Longmans, Green, and Co., 1917.) Price 6*s.* net.

WE are glad that Prof. Findlay's enlightening account of the facts and ideas of chemical science of to-day has reached a public large enough to require a second edition within about a year of its original publication. The work was described in our issue of August 31, 1916, as "a distinct and valuable addition to the popular literature of science"; and the encomium then passed upon it has been fully justified. A new chapter has been added on "Fermentation and Enzyme Action," but otherwise the volume remains unchanged. Not many works on chemistry can be followed with interest by lay readers, but this is one of the first rank, and it should long continue to perform the useful service of stimulating attention to chemical science for its own sake as well as for the value of its achievements to man.

CHEMISTRY AND THE WAR.

A RECENT issue of *Science* (June 15) contains an address by Prof. J. R. Withrow, delivered at the Columbus meeting of the Ohio Academy of Science, on "The Relation of War to Chemistry in America," which has certain features of interest for us at the present juncture. To begin with, it is a scathing indictment of the mentality of a people that can condone and even applaud the damnable conduct of their armies and Government at home and in the hapless countries for a time at their mercy. The nation seems to have become the willing, or at least the easily manipulated, pawn in the hands of unscrupulous statesmen.

We have not forgotten that it was a chemist—Ostwald—in the early days of the war, when he was acting as a spokesman for Germany to men of science throughout the world, who was quoted, when Germany was in the flush of her initial victories over Belgium, as saying the world had outgrown the idea of freedom for little or weak peoples.

The *Kultur* that can lead men of great mental endowments and catholicity of thought into such a mental position stands self-condemned. It affronts every instinct of charity and fair-dealing and stinks in the nostrils of right-minded men.

The greater part of the address, however, is concerned with a question of more immediate practical importance to chemists, namely, the influence of the war upon the progress and development of their special branch of science. Of course, it need scarcely be said that this world-wide cataclysm, affecting directly the most powerful and most highly developed of nations, has profoundly modified the course and trend of chemical progress. But it would be untrue to affirm that it has stagnated or declined as a consequence of war.

"Since," says Prof. Withrow, "war requires brains, science is of course utilised, and since the demand is inexorable, science must produce, and when science and engineering are producing, they grow."

It is stated that it requires three men in the shops to maintain one man in the Army and seven men for one in the Navy.

It is evident therefore that it is the applied portions of science that are most used, and hence that grow most under war's influence. It is common experience, however, that the stretching into new domains and the striving for new goals by applied science enrich the feeding-ground of unapplied science, and uncover fertile fields for the patient and quiet research which follows.

But there can be no doubt that, whatever the future may have in store for us, in the meantime progress in pure chemistry all the world over has been greatly retarded, and in proof of this Prof. Withrow points to the serious and progressive decline in the number of *Chemical*

Abstracts published by the American Chemical Society since the beginning of the war. It is claimed for this publication that, as the organ of a society of some 9000 members, it has for years covered the field of chemistry more thoroughly than any foreign journal of the kind. It reviews some 600 journals from all parts of the world, and is therefore a sure index of the world's chemical activity. The effect of the war on current chemical literature is plainly evident from the following figures:—

Total number of abstracts published (patents included).

In 1913	25,971
In 1914	24,338
In 1915	18,449
In 1916	15,784

Certain foreign chemical journals have ceased to be published since the war started, although the number is not large. Most of the French and German journals are published less frequently than in normal times, two or more numbers being contained within one cover. No important English, Italian, or Russian chemical journal has ceased publication. Eight German, thirty-one French, and seven Belgian periodicals more or less connected with applied chemistry no longer appear. Owing to the increased cost of paper, wages, etc., the cost of production of such as continue to be printed has greatly increased. In America, however, to judge from the cost of *Chemical Abstracts*, the increase has not exceeded 10 per cent. But this was before the entrance of the United States into the war.

As regards applied chemistry war has had two mutually antagonistic effects—one retarding, the other developing and benefiting. In the outset the war struck at all the main factors of success in chemical industry, and many branches in the United States, such as petroleum refining, turpentine and other wood products, were hard hit. Important markets were suddenly lost, and the importation of certain essential products ceased. Capital was, of course, at once discouraged, and stagnation inevitably set in. That the great German combines foresaw this result was evident from the manner in which, prior to the outbreak,

they organised American branches of their colour works, eliminating American employees to conceal the market and its peculiarities, and placing all their business in the hands of "American citizens" of German name. Then when the U.S. Bureau of Foreign and Domestic Commerce attempted last September to publish the amounts of each dye consumed in that country, they vigorously protested that their rights as American citizens were being infringed by encouraging competition. The uncovering of this octopus to public gaze should be set down to the war's credit. It has long been a familiar animal to many industrial chemists.

The tentacles of the "familiar animal" stretch, as is well known, even to this side of the Atlantic, and have struck deep into our industries. We may hope, in spite of Chancellor Michaelis, it is in a fair way to be exorcised.

Much of Prof. Withrow's address is concerned with the efforts which America has made, and is making, to free herself from the toils of the octopus, and he utters words of warning against the feverish and unintelligent haste with which she has thrown herself into the struggle. He gives a number of instances in which inexperienced capital has been led to squander millions of dollars on the unsuccessful plants and futile schemes of ignorant or unscrupulous chemical engineers. It is a "hustling" time in a country of "hustle"—with, as we are told, "disastrous results to capital and grave loss of confidence in chemical research." At the same time there has been much real progress. "The evils mentioned are largely growing pains." The progress in industrial chemistry and chemical engineering in America during the last three years has been wonderful.

"All this progress," says Prof. Withrow, "is in spite of the war. War," he holds, "could force us to do nothing we did not possess capacity for before. . . . Industrial chemical tendencies during the war have been governed by unusual demands for chemicals from abroad in addition to war drains, healthy home requirements, new demands from industries formerly supplied from abroad or forced to use new material by scarcity or high prices, together with speculation, raising prices to unusual levels. This resulted in expansion of existing plants, rapid installation of new ones, hasty perfecting of new processes already slowly maturing, and the seizing of opportunities to profit by high prices through erection of small plants for the production of special chemical materials and through the development of processes hitherto existing as possibilities only in the minds of chemists."

As was to be expected, this extraordinary activity has reacted upon the developments of chemical engineering and upon the manufacture of chemical appliances and manufacturing plant, and it is asserted that the progress in these departments has been as great during the past three years as has been accomplished in many previous decades.

It is gratifying to learn that this country is fully awake to the necessity of studying the after-war conditions of our chemical industries, as shown by Dr. Addison's reply to a deputation of the Association of British Chemical Manufacturers which recently waited upon him, in which the Minister of Reconstruction suggested the formation of an advisory committee which should co-operate with him in considering the problems which had been created by the large number of new factors arising out of the war. He thought that if we did not succeed in placing some British industries on a much firmer and more scientific foundation than they were before the war, it would be very discreditable to us all as a nation. This is undoubtedly a step in the right direction. But Heaven helps those who help themselves. However benevolent may be the intentions of a Government department, success will only be assured by the intelligent initiative and firm co-operation of the manufacturers themselves. To attempt to shape their policy at the bidding of a bureaucracy would almost certainly end in disaster.

T. E. THORPE.

SCIENCE AND INDUSTRY.[1]

THIS is the first of a series of papers which the Department of Scientific and Industrial Research proposes to publish, and it is a report of remarkable value and interest at the present time. It describes the progress made in the United States, chiefly in recent years, in the creation of institutions concerned in industrial research, and is illustrated by eighty-five excellent photographs of buildings and the interior of laboratories.

Fig 1—Laboratory car, Pennsylvania Railroad Company

Fig 2—Heat treatment laboratory, Pennsylvania Railroad Company.

It is pointed out that in this country the chief facilities for research are in the technical schools and universities, though the railways, steel-works, and some other industries have realised the need of laboratories and have provided them. But the staffs of colleges and universities, though well suited to carry on research in pure science, are not as a rule in touch with industry, and the amount of research required for industrial progress is beyond their resources. Hence it may be conceded that "the research facilities created to such an extent during the past two years are as yet quite disproportionate to the magnitude of British industry." This is true without the limitation to two years.

What is most striking about the condition of research in the United States is the large amount of money devoted to it. There are a number of manufacturing corporations the annual expenditure of which on research ranges from 10,000*l.* to 100,000*l.*, and there is a tendency for each large industrial firm to establish its own research laboratory. Thus the Eastman Kodak Company established a laboratory which cost 30,000*l.*, and though its annual cost is about the same, this is only 0·7 per cent. of the annual profits. The

[1] "Industrial Research in the United States of America." By A. P. M. Fleming. (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.) Price 1*s.* net.

General Electric Company expends annually on research 80,000*l* to 100,000*l*., and has a laboratory staff numbering 150. The Pennsylvania Railroad Company erected laboratories at a cost of 60,000*l*. for buildings and equipment, and a locomotive testing plant at a cost of 40,000*l*. The annual maintenance cost is about 100,000*l*. The laboratory cost is only about 0.6 per cent. of the value of the materials tested. Besides these private institutions there is the Bureau of Standards, on which the Federal Government spent 270,000*l*. for buildings and equipment, and to which it gives a subvention of 120,000*l*. a year. The Carnegie Institution of Washington, for encouraging investigation, research, and discovery, has an endowment of 4,500,000*l*.

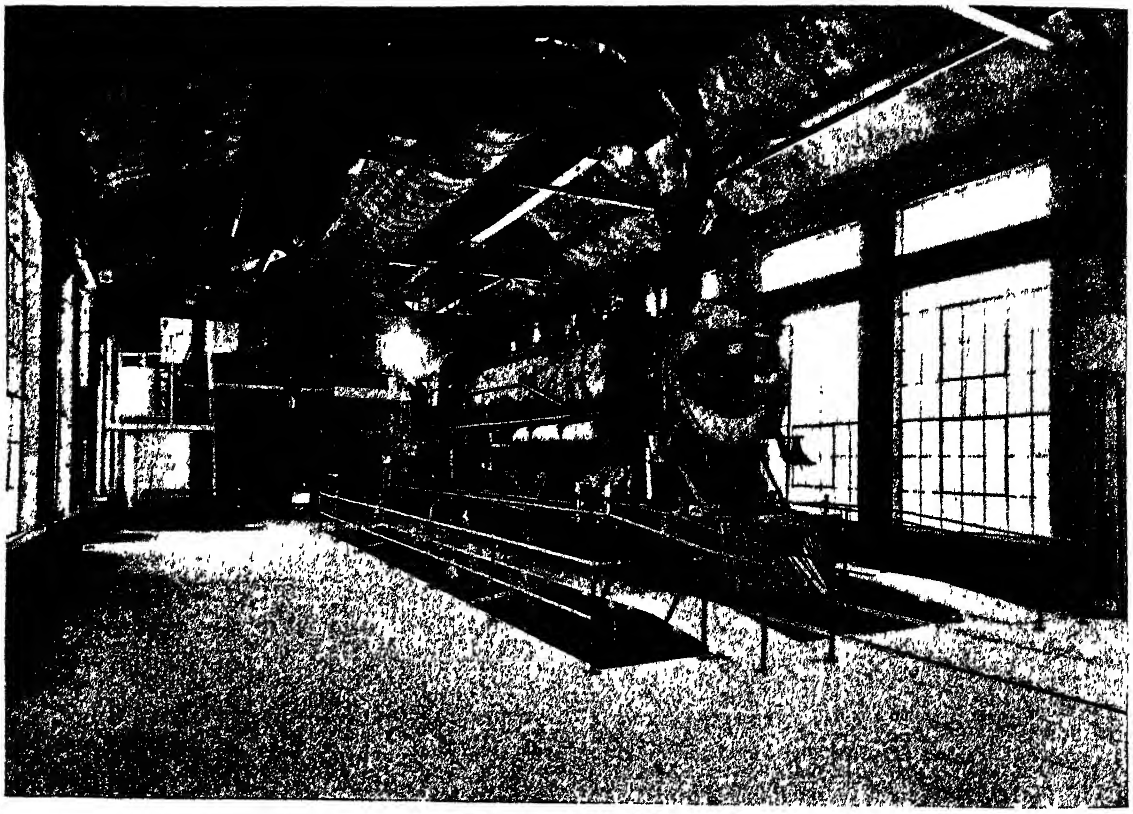

FIG. 3.—Locomotive testing laboratory, University of Illinois.

With regard to the very extensive laboratories of the General Electric Company at Schenectady, N.Y., it is stated that it is "generally acknowledged that the research laboratory has been an unquestionable financial success, not only because it has solved regularly the industrial problems of the large organisation with which it is connected, but also because it has produced discoveries which the company can turn to advantage. . . . Further, the research department is able to pronounce authoritatively, for the benefit of capitalists, on the probabilities of success of new projects involving considerations of a scientific character."

An example of commercial research laboratories is the Electrical Testing Laboratory at New York. This is controlled by the bond-holders of the Association of Edison Illuminating Companies. It has a floor area of 30,000 sq. ft. and a staff numbering 125. Its primary object is lamp testing, and about twenty million are tested annually. But it has also provision for chemical and fuel testing and photomicrographic work.

With regard to the universities and colleges Mr. Fleming says:—"A careful consideration of the conditions in the six States having the greatest manufacturing output fails to show, other than in isolated instances, very close co-ordination between university research and the manufacturing interests." But although in the report the work of universities is, we think, rather less adequately described than that of industrial companies, still there is evidence that it has been of great service, especially to the engineering industry. For instance, Michigan University has at Ann Arbor a tank for testing ship resistance, and its researches have been an important factor in the development of the special freight boats used on the great lakes. The Illinois University has a laboratory for investigations on a full-size locomotive engine.

A very interesting development in the United States is the creation of research fellowships by industries requiring special investigations. Thus, at the Worcester Polytechnic, Mass., four men are selected annually from the graduate class to pursue research work for an engineering firm.

During two years, half the time is devoted to research and half to preparation for a professional degree. At the end of the period these students enter the research department of the firm.

The Mellon Institute of Industrial Research, attached to the University of Pittsburg, was erected by Mellon Brothers, bankers, to provide manufacturers with the use of a well-equipped laboratory and trained staff at less cost than the establishment of a works laboratory. Any manufacturer requiring a subject investigated can endow a fellowship for one or more years, paying from 100*l.* to 400*l.* and also the cost of any special apparatus. The building cost 50,000*l.*, and the equipment 16,000*l.* A staff of seven men of high attainments supervises the researches. The director of the institute selects the fellows, usually men with a doctor's degree. Seventy-five fellows have been appointed in five years. The total amount spent in salaries and maintenance is 30,000*l.* a year.

A National Research Council has recently been appointed by the Academy of Sciences, at the request of President Wilson, to co-ordinate the scientific research work of the country.

The report, of which this is a very brief account, is extremely comprehensive, and should be read by all interested in the industrial progress of this country. The author draws some general conclusions, and suggests the establishment of an Imperial Industrial Research Laboratory, say, in the Midlands, controlled by a board largely composed of manufacturers.

RAINFALL AND GUNFIRE.

M. ANGOT, the eminent director of the French Meteorological Service, has made a valuable and authoritative contribution, published in the Journal of the French Academy of Agriculture for May, to the literature of a well-worn controversy. The alleged connection between rainfall and gunfire, in favour of which so many champions sprang up during the wet periods of 1914–16, has recently lost favour as a subject for argument, owing, no doubt, to the coincidence of the spring drought of 1917 with the Allied offensive on the Western front; but so short is the public memory, especially for negative evidence, that the incidence of 3 in. of rain during a recent summer afternoon in North-West London has proved sufficient to disinter the bone of contention. The mental attitude of the public towards a theory of this nature is of great psychological interest: there is little doubt that, should we experience this summer a repetition of the weather of July, 1888, when snow fell in London, followed by a recurrence of that of August, 1911, when the thermometer touched 100° F. at Greenwich, both phenomena would generally be attributed to the war.

Accordingly M. Angot's paper reaches us at an opportune moment. After dealing briefly with the historical aspect of the question, and alluding to the work of M. Le Maout—who, not content with having established a connection between the bombardments of the Crimean War and the rainfall of India, the United States, Nicaragua, and Barbados, went on to ascribe the diurnal variation of the barometer to the striking of public clocks and the ringing of church-bells—M. Angot proceeds to consider the physical changes which could be effected by the discharge of artillery, and could at the same time be held responsible for the causation, increase, or acceleration of rainfall.

The first proposition is that a succession of violent explosions might result in the displacement of masses of cold air at certain heights, which, coming under the influence of the upper winds and encountering layers of warmer, saturated air, could give rise to precipitation which would not otherwise have occurred: in this connection the author points out that in order to obtain a rainfall of so small an order as 1 mm. (0·04 in.), even if one were to take two equal masses of saturated air, the one at a temperature of 0° C., the other at 20° C. (an extreme case, of course), it would be necessary to effect a rapid and thorough intermingling of the two throughout a layer of air 6850 metres in thickness. In M. Angot's opinion, the mixing of layers of air may be the cause of cloud-formation or of slight drizzle at the earth's surface, but can never be responsible for considerable precipitation.

In the case of the second proposition—that water-vapour resulting from chemical reaction of the explosives might take effect—it is asserted that in order to produce the same amount of rainfall (1 mm.) as in the previous proposition the employment of no fewer than 21,750 tons of melinite per square mile would be necessitated—that, indeed, only on the supposition that all the hydrogen in the explosive became water-vapour which condensed immediately in its entirety and, so to speak, on the spot.

In the third and last instance, the possibility of electrical action being brought into play is considered in some detail. We know that supersaturated air (*i.e.* air which contains more water-vapour than it normally should be able to hold for the existing temperature) is a physical possibility, in the absence of dust-particles or other matter which may form nuclei for condensation. The necessary medium may be supplied by the action of ozone, of ultra-violet rays, by any cause, in fact, which can set up ionisation of the atmosphere; under this last category may be classed the detonation of high explosives, inasmuch as highly ionised gases result therefrom. The lower regions of the atmosphere, however, which alone are the seat of explosive activity on a large scale, always harbour large numbers of both ions and dust-particles, and cannot, therefore, be subject to supersaturation; while it has yet to be shown that the addition of quantities of ions or of dust-particles to a stratum of atmosphere nearly, but not quite, saturated can bring about premature condensation. Assuming for the moment the possibility of such a hypothesis, we must consider that no outpouring of ions or dust-particles can do more than accelerate a precipitation which would be necessitated sooner or later

by the progressive cooling of the air, since the mass of water that results from the cooling of, say, a kilogram of saturated air from 15° C. to 0° C. is constant (rather more than 5 gr.), whether or not supersaturation may have existed at the inception of the temperature-reduction.

Having thus pronounced upon the theories which have been advanced to account for the alleged connection, M. Angot goes on to consider whether in reality anything has occurred that needs accounting for—whether the rainfall since the outbreak of hostilities has been less inclined to observe the rules by which we endeavour to forecast its occurrence than before. Careful comparison between the daily weather-maps and the observed rainfall figures has convinced him that it is not. He points out, very rightly, that we have been passing through a series of wet years since 1909—a period that balances the run of dry years 1898–1904 (1903 and 1911 were both exceptions to their groups and may be said to balance one another)—and that excess of rain in 1915 and 1916 might reasonably have been expected; that 1909 was wetter (in France) than 1915, 1910 than 1916; furthermore, that during December, 1915, an unprecedentedly wet month, relative calm prevailed over the whole front, and that in the second ten-day period of the very wet February of 1916 considerably more rain fell (40 mm. as against 28 mm.) than in the last ten-day period, which witnessed the development of the giant German bid for Verdun. Similar conclusions will be reached if frequency of rain instead of amount be considered: 1910 had more rain-days than 1916; 1912 and 1913 both more than 1915, when the number in France was eleven below the average. The author has found nothing exceptional in the local distribution of rainfall: proximity to the firing-zone has not resulted in relatively greater totals or frequencies, while the great spring offensive of 1917 failed to interrupt the long spell of brilliant weather which accompanied it.

An examination was made some months ago at the British Meteorological Office into the local distribution of rainfall over England during the first twenty-two months of the war, the results of which afford corroborative evidence for M. Angot's last-mentioned point. It was found that the greatest excess of rain over the normal figure was one of 59 per cent. on the South Yorkshire coast; that three areas in Lincolnshire and on the Norfolk and Suffolk coasts respectively had rather more than 40 per cent. excess; but that round the North Foreland there was a slight deficit. No trace whatever of a distribution having reference to a centre over northern France was discoverable.

M. Angot concludes with the reflection that it may be with rainfall and gunfire as it is with weather changes and the phases of the moon, that "sous la suggestion d'une croyance instinctive on est conduit involontairement à ne remarquer que les coïncidences favorables et à s'affermir ainsi de plus en plus dans cette croyance." For those, indeed, who are cognisant of the relationship between the weather and modern warfare it is not difficult to see the possibility of the connection, but it is a connection in which the amount of gunfire varies inversely as the amount of rain that is falling rather than one which makes the rainfall in any way dependent upon the gunfire.

E. L. HAWKE.

NOTES.

M. PAUL OTLET, who is director of the International Institute of Bibliography at Brussels, has published a long and interesting memoir in the May–June number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* on the question of the establishment, in Paris, of a Central Information and Records Office for Industry. There are already in existence a certain number of enterprises of the kind, such as the *Mois Scientifique et Industriel* in France, the *Engineering Index* in England, and the *Repertorium der technischen Wissenschaften* in Germany, but their scope is limited. According to M. Otlet, the scheme should assume an international character, and its functions should be the collection, classification, and dissemination of all information available, both French and foreign, which will tend to facilitate and develop industry. A mere catalogue of works on particular subjects is not alone sufficient; a bibliography should be included in the scheme, so as to afford more detailed information on any desired subject. Books of all kinds, pamphlets, catalogues, descriptions of processes, journals, standard reference books of all countries, plans of machinery and plant, where available, a complete set of patent specifications, prospectuses of educational establishments, etc.—all would be collected and classified in accordance with a plan definitely laid down beforehand. Extensive card or similar indexes would be compiled for reference, and a complete catalogue on the decimal system, together with a bibliography, would be published at definite intervals. All these works would be available for free consultation by interested parties. Authors and publishers would be invited to co-operate in order to ensure the success of the enterprise. Existing publications, *e.g.* the International Catalogue of Scientific Literature, would be used as the nucleus of the work. It is to what the author calls the science of "documentation" that the Germans owe to a great extent the place they have attained in the industrial and military world, although they have often employed unscrupulous means to reach their end. He suggests that every industrial concern should have its own information and records department, which should be planned on the same lines as the national establishment, with which it should keep in touch. In connection with the question of patents, it was suggested at the Conference of Allies held at Paris last year that an international patent office be formed after the war, to save the time and expense now required for taking out patents in various countries. An undertaking of this nature would greatly increase the necessity for a more elaborate—practically an international—Record and Information Office to enable all questions of priority and infringement to be dealt with efficiently. Every phase of an important subject is reviewed in this memoir of thirty pages.

WITH a view to the just apportionment of pensions due to soldiers for injuries received in the present war, the French Government has established at Paris, at the instigation of Dr. Camus, a well-known military surgeon, a special centre for determining scientifically the extent of incapacitation. This establishment will serve both as a research laboratory and for the additional treatment of those who have already undergone the usual hospital treatment. Here special

measurements are carried out with instruments designed by Dr. Camus, these measurements having reference to (1) the anatomical condition, and (2) the physiological function of the injured part. The special instruments include those for measuring the movements of the joints, a special dynamo-ergograph for studying small movements, a device for recording vaso-motor disturbances, and an apparatus for recording trembling. The methods of this laboratory permit of replacing the long descriptions of specialists by documents of a more complete and scientific nature, *i.e.* photographs, numerical tables, curves, etc., which can only be interpreted in one sense. The insurance companies are interesting themselves in this new method of determining bodily efficiency, and hope to employ it in all cases of disputes arising out of compensation awards for accidents. The writer of the article in *La Nature* for July 28 (from which this note is derived) hopes that this system of evaluation will prevent exaggerated claims and make for equity of treatment as regards the pension to be paid to the partially disabled.

It is stated in the *Scientific American* that Dr. G. Müller has been appointed director of the astrophysical observatory at Potsdam, in succession to the late Prof. K. Schwarzschild.

The Baly medal of the Royal College of Physicians of London has been awarded to Prof. W. M. Bayliss, and the Bisset-Hawkins memorial medal to Sir A. Newsholme.

The Edward Longstreth medals of the Franklin Institute have been awarded to Prof. A. E. Kennelly and Messrs. F. H. Achard and A. S. Dana, for their joint paper on "Experimental Researches on the Skin Effect in Steel Rails."

According to a telegram from Wellington, New Zealand, a violent earthquake has occurred in the southern portion of North Island, causing great damage. The Wairarapa district suffered most. The earthquake is described as the worst since the upheaval in the 'fifties.

We learn from *Physis* that Dr. G. R. Wieland, of Yale University, U.S.A., has spent the last season in collecting fossil plants in the Argentine Republic. He has paid special attention to the Rhætic formations of Mendoza and the Lias of Neuquen.

The Rockefeller Foundation, with the co-operation of the Philippine Government, is sending a hospital ship to the Moros and allied tribes of the Sulu Archipelago. It is intended that the ship shall cruise for five years among the many islands in the southern Philippine group, the Rockefeller Foundation having learned that many of the Moros are suffering from skin diseases, malaria, hookworm, dysentery, and other diseases.

A special series of preparations has just been placed on exhibition at the Horniman Museum, Forest Hill, S.E., to illustrate the stages in the life-histories of numerous insects which damage the food plants grown in gardens and allotments. Specimens and models showing the damage done are also exhibited, and means of combating the pests indicated. Visitors to the museum may obtain there copies of the leaflets of the Board of Agriculture dealing with the insects shown.

Exceptionally heavy rains occurred over the east and south-east of England during the closing days of July and on the opening days of August. For the four days from July 30 to August 2 inclusive the rains were heavier in many parts of London than for any similar period for the last twenty-five years. At South Kensington, the recording station of the Meteorological Office, the measurement for the four days was 3·28 in., which is 70 per cent. of the average London fall for July and August combined. According to the weather reports from the health resorts the rainfall at Southend was 3·44 in., which is 89 per cent. of the average fall for July and August, and at Margate 3·48 in., being 84 per cent. of the average for the two months. At Hastings the rainfall measured 3·16 in., at Eastbourne 2·60 in., and at Bournemouth 2·00 in. In the northern and western parts of England the rainfall was slight, and in the midlands it was by no means heavy. The subsequent rains in the south-east of England have been frequent, but not heavy. During the period of the heavy rains the temperature was very low for the time of year, and on several days the midday temperature remained below 60°. The disturbances which occasioned the rains in England also caused very wet weather in Flanders and other parts of north-western Europe.

In *Science Progress* for July Prof. Flinders Petrie contributes a valuable paper on "History in Tools." He points out that while there are many books on offence and defence, arms and armour, there is none that traces the history of our mechanical aids. Thousands of writers have described the sculptures of the Parthenon, but not one has described the means used in performing that work. It is a mystery to us how fluted columns with an entasis could be produced, true to a hundredth of an inch, in the diameters between the deep groovings. He goes on to describe the evolution of tools from the age of Stone to that of Iron, and he sums up the discussion in the following words:—"Thus the spread of forms throughout the ancient world illustrates the movements of trade and of warfare, while the isolation of various types at the same time shows how efficient and self-supporting the ancient civilisations were in most requirements. The history of tools has yet to be studied by a far more complete collection of material, above all of specimens exactly dated from scientific excavations. It will certainly be, in the future, an important aid in tracing the growth and decay of civilisations, the natural history of man."

The report of the Somerset Archæological Society is, in spite of difficulties caused by the war, which have impeded the excavations at Glastonbury, a record of steady progress. The great work of the year is the completion of the report of excavation of the Lake Village at Glastonbury, on which Dr. A. Bulleid and Mr. St. George Gray are to be congratulated. The society has wisely organised an advisory committee on church restorations in the county, which will, it may be hoped, secure the protection of ancient ecclesiastical buildings, and prevent any proposed restorations which threaten to destroy their archæological value.

In the July *Quarterly Review* there is a clearly written and shrewd article on the problem of degeneracy by Dr. A. F. Tredgold. He defines degeneracy as "a retrograde condition of the individual resulting from a pathological variation of the germ-cell," and suggests that the word "decadency" might be used to denote the somatic modification arising from a defective environment. Any usage which will keep two distinct conditions from being confused with one another will be a gain in thought and action. To prevent hereditary retrogressive variations being continued and diffused is the problem of restrictive or negative eugenics, but can we not discover how they arise? (1) Some investigators—*e.g.* Dr. C. B. Davenport—believe that feeble-mindedness means a perpetua-

tion of a distantly ancestral or Simian condition. But feeble-mindedness as we know it does not look like a stage in an evolution that went on! Mosckoff is more explicit. He traces all degeneracy and much else to the persistently assertive influence of a Pithecanthropus strain, which unfortunately got mixed up long ago with that of "white diluvial man," who seems to have been a sort of Apollo. (2) Another so-called theory is that retrogressive variations are fresh "spontaneous" sports, bad shots on the part of the changeful germ-plasm. But there are few who are inclined to rest satisfied with the word "spontaneous," which is only a confession of ignorance. (3) So the third view is that retrogressive variations arise as variations conditioned by a disturbing, depressing, or deteriorating immediate environment, such as toxic conditions of the parent, which may induce senescence or enfeeblement in the germ-cells. The author might have referred with effect to the striking experiments of Werber, which show how toxic agents, like butyric acid and acetone, produce no end of monstrosities in the developing fish-embryo. Perhaps, as Werber suggests, parental metabolic toxæmia higher up in the scale may account for degeneracy in the offspring. Dr. Tredgold directs attention to the fact that the chief expression of degeneracy occurs in the most elaborate, and phylogenetically the most recent, part of the organism—namely, the higher parts of the brain. From his own experience, he notes that all the offspring of two markedly degenerate persons are always defective, and that those resulting from the union of a pronounced degenerate with a healthy individual tend to be, not some normal and some abnormal, but all abnormal.

IN the *Revue Scientifique* for July 14–21 M. André Godard directs attention to the important services rendered by birds to agriculture. The depredations of insects on cultivated crops, both at home and abroad, he points out, are so serious that it is well that we should realise their extent and the good that is done by truly insectivorous species of wild birds. The opinions of many authorities are quoted, and figures given in support of their various statements, which show that enormous numbers of insects, insect larvæ, and eggs are annually destroyed by birds, which, if permitted to live, would make profitable cultivation impossible. M. Godard is of opinion that although many species may appear to be injurious, they are really beneficial when the nature and quantity of their food are carefully considered. He seems to regard the situation as one in which we must be content to put up with a small amount of damage by birds or absolute disaster due to injurious insects. Whilst fully agreeing with all the author claims for the truly insectivorous species, we must differ from him in regarding the damage done as small, and bearing in mind that the truly injurious species are comparatively few in number, we think that agriculture will best benefit by the elicitation of a thorough and detailed knowledge of their feeding habits and the nature of their food throughout the whole of the year, and the enactment of wise measures for the destruction of such species as are known to be too plentiful. We believe that in France, as in Great Britain, many of the insectivorous species of wild birds have suffered owing to the unrestricted increase of the commoner and injurious species, and the situation is one that will not improve by neglect or by the shutting of one's eyes to the actual facts.

THE *Scottish Naturalist* for July–August is entirely devoted to the report on Scottish ornithology in 1916 by the Misses Leonora Rintoul and Evelyn Baxter. This in every way maintains the high standard of their reports of former years. One of the most striking of the many good things they record concerns the herring-gull, nesting on the cliffs at North Uist and the Skerries. After building their nests, which they seem to have done in normal numbers, very few of them laid eggs, and fewer still hatched out young, not more than a dozen being brought off where there used to be scores. So far no explanation of this state of affairs is forthcoming, though it was believed, in the case of the North Uist birds, that this failure was due to the plague of rats which infests the cliffs there, but it is clear, they remark, that this explanation fails. The presence of rats in such conspicuous numbers on cliffs facing the sea is in itself a noteworthy fact, and should be kept under observation. "One of our correspondents," they write, "records about twenty pairs of red-necked phalaropes." But the precise breeding-place of this bird is rightly withheld. Another note concerns the spotted flycatcher, eight or nine of which were watched catching flies over a big pool in the Malzie Burn, Corsemalzie, where one of them was seen to alight several times on the still water.

MR. N. HOLLISTER, superintendent of the National Zoological Park, Washington, in the Proceedings of the United States National Museum, vol. liii. (June), records some valuable notes on the effects of environment and habit on captive lions, which will be read with interest, not only by those desirous of obtaining data of this kind, but also by such as are responsible for the selection of specimens for museums. The author shows clearly enough that captivity produces very marked changes, both in the coloration and length of the pelage and in the skeleton, particularly in the skull, where the regions affected are chiefly the areas of origin for the muscles concerned with the seizing of the prey and with certain of the masticatory muscles. Further, the brain capacity in captive lions is much less than in wild specimens.

THE April issue of the *Agricultural Journal of India* (vol. xii., part ii.) contains two notes from different sources on materials said to be now used in Germany as substitutes for jute, and their probable significance as future competitors with Indian jute. Waste paper and cellulose are dismissed as unlikely to be more than war-time substitutes, but a more serious view is taken of the possibilities of the two plants, *Epilobium hirsutum* (hairy willow herb) and Typha (reedmace), which are said to be now utilised for fibre by the Germans. The opinion is expressed that the former is unlikely, for some time at any rate, to prove a serious competitor, owing to the necessity for prolonged cultural improvement of the plant before good fibre-producing strains can be evolved. Typha fibre, according to a quotation from the *Chicago Daily News* of October 1, 1916, would appear to be a more formidable competitor. It is claimed in Germany that this material, "if it meets with expectations," will make Germany independent of the importation of cotton, jute, and wool, and the further assertion is made that Germany so early as next year will make enough of the material to equal all the supplies usually imported, largely from America and Egypt. Capital for the exploitation and manufacture of this material has been subscribed by "the greatest spinners, merchants, and bankers of Germany," and attention is being directed first to the development of the coarser grades of material.

THE June issue of *Tropical Life* contains a review by Mr. H. C. Brill, of the Bureau of Science, Manila, of the outlook for the alcohol industry in the Philippines and the tropics generally. Three of the cheapest sources of alcohol occur in the tropical countries, namely, sugar-cane molasses, "tuba" from the nipa palm, and possibly from the coconut palm, and starch from the starch plants, such as cassava and arrowroot.

The two former sources are already utilised to a considerable extent, the second largely predominating. In 1914 the islands produced about 12,000,000 proof litres of alcohol, of which more than 95 per cent. was made from the sap (tuba) of the nipa and of the coco palms. The molasses fermentation industry has suffered much from faulty methods, but considerable improvement is being effected through the activities of the Bureau of Science. The nipa palm offers a cheap source for the production of alcohol, each fruiting stalk yielding normally 30 to 50 litres of sap during a season, equivalent to an output per hectare of fully 30,000 litres of juice with an average sugar-content of 15 per cent. The utilisation of starch plants still awaits development. It is estimated that an average acre of cassava would yield more than three times as much starch as an average acre of maize, whilst, in addition, the cassava contains 4 to 6 per cent. of fermentable sugars. Arrowroot yields 18 to 22 per cent. of starch, and is no more difficult to handle than potatoes. It is predicted that when these sources are developed the tropical countries will secure a practical monopoly of the alcohol industry.

THE thickness of a covering of peat is often cited as giving some clue to the age of the surface on which it grew. Mr. S. R. Capps's recent remarks ("The Chisana-White River District, Alaska," Bull. 630, United States Geological Survey, p. 72) are thus of general interest. He points out that a seedling spruce sends out its first radial roots on the mossy soil, and, in a high latitude, follows these by others at higher levels, as the moss thickens and the food-supply from below is cut off through the rising of the level of ground frost. Hence, under such conditions, "the vertical distance between the lowest horizontal roots of a living tree and the surface of the ground represents the thickness of the peaty accumulation during the lifetime of the tree." Mr. F. V. Coville has informed Mr. Capps that trees of very slow growth may fail during unfavourable years to form distinct annual rings, and that the estimate of the age of the peat-layer by the age of the trees must take this into consideration.

MR. W. G. FOYE, in a paper on "The Lau Islands of the Fiji Group" (*Amer. Journ. Sci.*, vol. xliii., p. 343, 1917), concludes that there is here positive evidence of subsidence, and very good evidence of the development of atolls and barrier reefs during such subsidence. He regards, however, a general depression of the Pacific area as unlikely, owing to the irregular occurrence of uplifted and subsided blocks.

MR. J. COGGIN BROWN continues his description of "The Geology of the Province of Yünnan in Western China" in the Records of the Geological Survey of India, vol. xlvii., p. 205. The Silurian fossils collected have been determined by Mr. F. R. Cowper Reed, of Cambridge. The paper, with its foundation of hard travel, and its geographical observations interspersed with details of stratigraphy, reminds one of those of the pioneers of the last century, and the illustrations show what fine adventure awaits the surveyor on the borderlands of the British Empire.

THE Riviera or Ligurian earthquake of February 23, 1887, was one of the first earthquakes instrumentally recorded beyond the limits of the disturbed area. In the early estimates of the velocity there was considerable discordance, and a new estimate has therefore been made by Messrs. Agamennone and Cavasino (*Rend. della R. Acad. dei Lincei,* vol. xxvi., 1917, pp. 167–71). Taking the position of the epicentre as about 20 km. south of P. Maurizio, and using the twenty-eight best estimates in which the initial epoch is given, they find the mean velocity to be 2·54 km. per second, and the time at the epicentre 6h. 21m. 9s. a.m.

PROF. OMORI's fifth memoir on the recent eruptions of the Asama-yama (Bull. Imp. Earthq. Inv. Com., vol. vii., No. 2, pp. 217–326) contains a list of the earthquakes and earth-tremors registered at Yuno-taira during the six warmer months (May to October) of each year from 1913 to 1916. This seismological station is situated on the west-south-west slope of the volcano, at a distance of 2·3 km. from the centre of the crater. As in his earlier memoirs, Prof. Omori divides the volcanic earthquakes into two types—the A-type, not directly accompanied by outbursts, and the B-type, caused by eruptions. The former consist of quick vibrations and are usually of very short duration, the latter of slow gentle movements and of comparatively long duration. The tables show, as Prof. Omori remarks, that the former earthquakes have increased in frequency from 34 in 1913 to 229 in 1916, while the latter have declined from 7126 in 1913 (all but 25 corresponding to very small outbursts) to none in 1915 and 2 in 1916. Since May 5, 1914, there has been no strong outburst of the Asama-yama.

A NEW acid sodium phosphate is described by Dr. J. H. Smith in a recent number of the Journal of the Society of Chemical Industry (vol. xxxvi., No. 8). The formula attributed to it is $Na_4P_6O_{17}$, or $6Na_2O,9P_2O_5$. It is notable as having a very energetic corrosive action upon glass, porcelain, nickel, and even platinum and silica. The author describes also a method for the titration of mixed phosphates by employing two indicators, methyl-orange and phenolphthalein, at 55° C., and shows that by this means it is possible to determine readily the proportions of the three sodium salts of orthophosphoric acid when present together in a mixture.

SOME lines of possible research, with a view to the better utilisation of by-products from the coking of coal, are outlined by Mr. G. E. Foxwell in a recent number of the Journal of the Society of Chemical Industry (vol. xxxvi., No. 10). Recovery of sulphur from the pyrites of the coal, so that, together with the ammonia given off in coking, it could be obtained as ammonium sulphate is one of the problems to which a solution is required. Where the chlorine content of the coal is sufficiently high, it also may be recovered with the ammonia in the form of ammonium chloride, and in a few cases this is, in fact, already done. Improved methods for the recovery of naphthalene and benzol are required, as also for the utilisation of the surplus gas from the coke ovens. This gas, the author calculates, is equivalent to more than a million tons of coal per annum, and in a great number of cases is got rid of by being allowed to burn away. It might possibly be used as a source of certain chemicals—*e.g.* chlorinated hydrocarbons—or utilised in gas-engines to generate electricity for distribution, or the gas itself might be distributed in mains to neighbouring towns.

IN the issue of *La Nature* for July 14, M. Le Chatelier gives a brief survey of the progress of high temperature measurements. He points out the main causes of error that are likely to arise in using the thermo-electric type of instrument, though, as he remarks, troubles have been largely eliminated by the use of improved types of galvanometer of the moving coil pattern. Great care is required in the graduation of the instruments, and frequent regraduation is necessary. One of the great advantages of the thermo-electric pyrometer is that it lends itself readily

to photographic recording. A spot of light from a slit or hole is allowed to fall on to the mirror of a mirror-galvanometer, whence it is reflected on to a sensitised plate. This method is frequently used nowadays in investigating the critical points of steel. The writer mentions the recording apparatus thought out by M. Saladin, which permits of tracing all kinds of curves on a photographic plate by using two mirrors both capable of rotation about a vertical axis and operated by two galvanometers. A fixed mirror, inclined 45° to the horizontal, is placed between the two moving mirrors. The ray of light reflected by the first mirror is thus given a horizontal movement, which becomes vertical after reflection by the fixed mirror at 45°. It is then reflected on to the second mirror, which imparts to it a second and final horizontal displacement. Finally, the combination of these two perpendicular movements traces a curve on a stationary photographic plate. It is thus possible to plot directly curves of electric resistance, of dilatation, and of E.M.F. in terms of temperature.

IN view of the importance of internal waterways and of the many questions which revolve round the development of the hydraulic resources of their country, the National Association of Navigation Congresses in Italy has inaugurated the publication of a small periodical of eight pages, known as *Navigazione Interna*, to deal with matters of interest in that connection as they arise. The first issue, for May, 1917, lies before us and contains an account of the work of the Hydrotechnical Institute at Stra, associated with the University of Padua and the Hydrographic Department at Venice, describing in particular the experimental tank 200 metres (656 ft.) long, with a bottom width of 3·70 metres (12 ft.), a top width of 10·75 metres (35¼ ft.), and a mean depth of 3·50 metres (11½ ft.). The tank is constructed in cement concrete, with light metal reinforcement, and is fitted with a moving platform and the appropriate mechanical equipment. The institute undertakes experimental work in connection with all hydraulic problems, including those in regard to the resistance offered to the movement of solid bodies in water. Another interesting article in the journal deals with a Swiss project of a navigational connection between Lake Maggiore and the River Po. We welcome the advent of this latest recruit to the service of hydrological science.

EVIDENCE of the difficulty of destroying reinforced-concrete buildings is given in an article on concrete in war in the *Times Engineering Supplement* for July 27. Steel cupolas have been blown to fragments by high-explosive shells, while similar structures in reinforced concrete have survived the ordeal with comparatively little injury. Many of the reinforced concrete buildings plentifully scattered over Northern France have been used by the Germans as well as by ourselves, and have shown remarkable capacity for withstanding artillery fire. One case quoted is of an elevated reservoir measuring about 80 ft. long, 40 ft. wide, and 12 ft. deep, supported on a framework of thin columns more than 40 ft. high, with horizontal bracings. The flat roof at a height of 55 ft. was used by the Germans as a ready-made observation post. This reservoir, built in June, 1911, of Hennebique ferro-concrete, was destroyed so far as possible when the Germans evacuated the town in March last, having successfully withstood our bombardment, which destroyed all surrounding buildings. The columns were broken by explosives, allowing the reservoir proper to fall to the ground, where it remained intact save for a few cracks and holes cut in the corners, where explosives had been inserted with the object of trying to damage the walls.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW STAR.—According to the *Times* of August 6, the discovery of a new star by Mr. Ritchey on July 19 has been announced by Prof. Pickering. The star is very faint, being of the 14th magnitude, but it may be of special interest because of its situation in the nebula N.G.C. 6946. This is a large faint nebula in Cygnus, its position being R.A. 20h. 33m. 17s., decl. +59° 51'.

STELLAR MOTIONS AND ABSOLUTE MAGNITUDES.—The relationship of stellar motions to absolute magnitudes has been further investigated, as regards 1300 stars of types F, G, K, and M, by W. S. Adams and G. Strömberg (*Astrophysical Journal*, vol. xlv., p. 293). Parallaxes determined by the spectroscopic method were available for about 700 of the stars used, and these were supplemented by others derived with the aid of a new formula connecting mean parallax with proper motion. From the parallaxes and apparent magnitudes, the absolute magnitudes are easily calculated, being defined as apparent magnitudes reduced to the distance corresponding to a parallax of 0·1". The stars being divided into groups defined by certain limits of parallax, it is first shown that among stars at the same distance from the sun there is an increase of radial velocity with decrease in absolute brightness, and that there is little evidence of any variation in radial velocity depending upon distance from the sun. For the spectral types considered, the increase in velocity is 1·5 km. for a decrease in brightness of one magnitude. It is shown that this effect cannot be ascribed either to distance from the sun, to the law of frequency-distribution of the velocities, or to the effect of stream motion. The same conclusion is reached with regard to the cross linear motions of the stars, and it appears to hold in the mean for apparent as well as for absolute brightness The stars of types K and M have mean velocities about 1·0 to 1·5 km. higher than the F and G stars of the same absolute magnitude.

UNION OBSERVATORY, JOHANNESBURG.—Circular No. 37 of the Union Observatory includes measures of ninety-eight double stars and the results recently obtained by the blink microscope in connection with proper motions and new variable stars. On twenty-three pairs of plates taken at the Melbourne Observatory, at intervals averaging about twenty years, 104 proper motions were found and measured, twenty-three of the stars having a centennial proper motion of 20" or more; fifty-six of these stars have a motion nearly parallel to the galactic plane and towards the solar ant-apex. Proper motions amounting to only 0·04" or 0·06" a year were easily and certainly determined. A disagreement with the results from astrographic measurements in the case of three pairs of plates taken at the Cape Observatory has led to an interesting correspondence with Prof. Kapteyn. The general impression obtained by Mr. Innes from his work with the blink microscope is that practically all stars, nebulæ, and clusters in any one region are at the same distance from us, and that with very few exceptions they are all relatively fixed. In Circular No. 38 Mr. Innes announces an important undertaking in the form of a photographic map of the southern sky, from the Franklin-Adams star plates. Each chart will be ruled with hour circles and parallels, and will cover a little more than 30 square degrees, the scale being 36 mm. to 1°. The region to be covered will require 556 charts. An excellent specimen chart accompanies the circular, and others will be issued as opportunity offers.

THE EXAMINATIONS FOR CLASS I. OF THE CIVIL SERVICE.

IN November last a Treasury committee was appointed to consider and report upon the scheme of examination for Class I. of the Civil Service. The committee consisted of Mr. Stanley Leathes, C.B., First Civil Service Commissioner (chairman); Sir Alfred Ewing, K.C.B., Vice-Chancellor of the University of Edinburgh; Sir Henry Alexander Miers, Vice-Chancellor of the University of Manchester; Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield; Prof. W. G. S. Adams, Gladstone professor of political theory and institutions in the University of Oxford; and Mr. D. B. Mair, M.A., director of examinations to the Civil Service Commissioners, to be secretary to the committee.

Mr. Fisher resigned his membership of the committee on his appointment as President of the Board of Education, and Dr. W. H. Hadow, principal of Armstrong College, Newcastle, and Vice-Chancellor of Durham University, was appointed in his stead.

The committee was instructed "to consider and report upon the existing scheme of examination for Class I. of the Home Civil Service;

"To submit for the consideration of the Lords Commissioners of his Majesty's Treasury a revised scheme such as they may judge to be best adapted for the selection of the type of officer required for that class of the Civil Service, and at the same time most advantageous to the higher education of this country;

"And in framing such a scheme, to take into account, so far as possible, the various other purposes which the scheme in question has hitherto served, and to consult the India Office, the Foreign Office, and the Colonial Office as to their requirements, in so far as they differ from those of the Home Civil Service."

The report of the committee, dated June 20, 1917, has now been published (Cd. 8657), and the outstanding points of the new scheme proposed for the examinations of the future are printed below. We hope next week to deal with the report as a whole.

Scheme Proposed by the Committee.

This scheme should be established on a basis of equality of studies; that is, of the chief studies which are pursued by students at the university up to the conclusion of an honours course. We propose to place on an equal footing the main schools of: Classical languages, history, and literature; modern languages, with history and literature; history; mathematics; and the natural sciences. The classical subjects will be valued at 800 marks; history and mathematics at the same; candidates in natural science taking one main subject up to the higher level and two subsidiary subjects on the lower level can obtain the same totals; while two modern languages studied as comprehensively as the classics will be worth the same. It is possible, however, that for some time candidates able to take full advantage of this last opportunity may be few. We propose that the candidate coming from any one of these schools shall be encouraged—it might almost be said constrained by the force of competition—to offer one or two other additional subjects estimated by us as the equivalent of one-fourth part of his whole main subject. This addition, valued at 200 marks, may be made up in many ways, and we do not propose to limit in any way the free choice of candidates. There is also a great range of university studies—political, legal, economic, and philosophical—which have not been as yet, so far as we know, consolidated into one honours school, though the courses offered by the London School of Economics may cover the most part of them. We have greatly increased the individual and collective weight of these studies, but we do not consider it desirable that candidates for the Civil Service should study exclusively either politics, law, economics, or philosophy; however, for students whose chief interest lies in two or more of these subjects we offer a varied field of selection which is fully equivalent to that appertaining to any of the schools mentioned above.

While grouping subjects as above, and expecting that on the whole the main choice of candidates will be in one or other of the groups, we retain for subjects of university study the old freedom of selection. Whatever limits we imposed upon the choice of candidates, we should still be confronted by the difficulty of equating disparate subjects; *e.g.* language including literature and history, mathematics, history, natural sciences. That difficulty has to be solved as best it may by the Civil Service Commissioners and their permanent and occasional staff. It will be no greater under our proposed scheme than it is under the existing scheme. Moreover, we think it would be difficult to make up a list of subjects under our proposed scheme which would not secure a useful university education, either narrower or wider.

But we do not consider it necessary to confine our tests to the results of university study alone. The young men who will be examined by the Civil Service Commissioners will have spent not only three or four years at the university, but ten or more years at school; and the best of them will have had abundant leisure in which to educate themselves and pick up knowledge and accomplishments useful to them in the work of life. Much that they have learnt at school they will quite rightly have forgotten, but that knowledge should have served its purpose; and we do not propose to examine our candidates in school subjects. But we consider that a sound and systematic education should show certain results at university-leaving age; and that candidates who, while devoting themselves to their individual studies, have nevertheless retained an alert and acquisitive mind and have kept their eyes open to the most important facts in the world around them, should have seized and retained a certain amount of knowledge—scientific, economic, and political. We consider it also highly desirable that all Civil Servants should have a good working knowledge—that is, a reading and translating knowledge—of at least one modern foreign language, preferably two.

On this basis we have constructed a separate section that all candidates must take. We consider that all well-educated young men should be able to use the English language skilfully and accurately and to grasp its meaning readily and correctly. This accomplishment is specially valuable for Civil Servants, but any form of education that has not developed it has failed in a principal part of its purpose. We therefore propose in the first place that all candidates should write an essay. To construct an essay and work out therein a line of thought with suitable words, logical order, and just proportions is a severe criterion of ability. But it is found by experience that an excellent candidate may on any one occasion fail to do justice to his powers. We therefore propose that candidates should have in other papers opportunities of manifesting like powers of arrangement and effective expression. One of these papers should be a test in English (Section A, subject 2), the nature of which may best be understood by reference to the specimen paper supplied.

Further, we propose a paper in modern subjects, social, political, and economic. A specimen paper is supplied. It may be found that many—perhaps most—young men of our country are unduly ignorant of such matters. But the existence of this test should encourage many to turn their attention to these subjects and accumulate in their leisure much useful information It should be noted throughout this Sec-

tion A that no candidate will be disqualified for failure in any part, or in the whole of the section, though, since we allow 500 marks for the written part of the section, there is much advantage to be gained or lost thereby in the whole competition.

We have received from the Government Committee on Science in the Educational System of Great Britain the following resolution:—

"The committee has had under its consideration certain proposals for remodelling the Competitive Examination for admission to Class I. of the Civil Service at home and in India or in the Colonies. It is unanimous in thinking that it is indispensable that a course in science extending over several years shall have formed a serious part of every candidate's previous education. It is, however, not prepared to trespass on the province of the committee which is dealing in detail with this examination. It feels strongly that if the men with high scientific qualifications who will undoubtedly be needed in the Service to a greater or less extent are to be secured at a comparatively early age by this examination, then candidates offering science only (without mathematics) should in future be placed on complete equality with other candidates, and that this is not the case at present. But it recognises that there may be advantages in obtaining also by other methods scientific advisers for the Service at a greater age and with practical professional education."

With the trend of this resolution we find ourselves in general agreement; and we desire to make it clear that by placing science, as we have endeavoured to do, on a complete equality with other subjects of a university course, we do not expect to make it possible for certain departments to dispense with scientific advisers selected in maturer age and possessed of practical experience and of knowledge of a kind that may have to be obtained elsewhere than at a university. And in some departments specialists in one or another branch of science will doubtless be selected by tests of a less general kind than that with which we are concerned. The young men selected under our scheme partly for their knowledge of natural science, unless they happen to be employed in a scientific branch of the department in which they are working, may have no opportunity of exercising their scientific acquirements and their knowledge may pass out of date. They should, however, not lose a just estimate of scientific knowledge, and they should know when and where it may with advantage be sought.

We must, however, make one reservation to the terms of this resolution. The "indispensable" requirement of a school course in science must apply rather to the future than to the present. We cannot now correct the defective education of the past or rule out from our competition for some years to come all those useful candidates who may not satisfy this demand of the Science Committee. Perhaps later it may be possible to require of all candidates some form of school certificate which may be evidence of suitable training in this and some other subjects not tested by the examination.

However, we think we may even now go so far as this. We can give a substantial advantage in the competition to those candidates who by whatever means have obtained and retained a sound knowledge of some of the principles, methods, and applications of science, and are able to give a lucid and intelligent account of their knowledge. [Specimen questions are supplied.] It is hoped that the inclusion of this subject in the scheme will encourage all candidates to make themselves acquainted with the general principles of science. This paper will also be a test of orderly, effective, and exact expression.

Finally, we propose to allot 100 marks for a translation paper from some modern foreign language. We intend this paper to be a serious test of capacity to understand and translate accurately passages from the foreign language. We do not propose to limit the scope; verse may be set as well as prose; but nothing that is antiquated should appear; the candidate should be able to master any passage that is likely to occur in books of ordinary difficulty written in the living tongue; passages dealing with history and politics may be set, but not any technical matter. This should be not only a test of specific knowledge, but also a test of capacity to use the English language with skill and accuracy. The languages mentioned in our list are those which appeared to us most likely among European languages to afford information useful to students or to Civil Servants, or to both. We include Latin as an option for those candidates who take two modern languages because Latin is commonly imposed at school upon those pupils who take modern languages, and we do not wish to lay any unnecessary burden on the modern language candidates. In any case, for candidates who have mastered two languages, classical or modern, there should be no hardship and much advantage in acquiring a third.

Since it is of high importance that Civil Servants should have ready use of two modern languages, we include among our recommendations that any candidate who wishes to offer a second modern language on the same terms as in Section A should be permitted to do so beyond the limit of the subjects prescribed in Section A and those permitted in Section B. To acquire a modern language for reading and translation purposes should not be a difficult task for any well-educated man; it can be done in leisure time with a little assistance. But some adequate motive is needed to induce the effort; an effort which should be made by students of history, natural science, politics, economics, and, indeed, of almost all the subjects in our schedule, but, in fact, is not always made. We trust that in course of time all our candidates will be prepared to offer two modern languages up to a useful standard, but we do not at present propose to make two compulsory. We hold out an advantage to those who offer two, but success will be possible with only one, and in some cases perhaps without any.

VIVA VOCE EXAMINATION.—The Royal Commission expressed a cautious inclination towards a *viva voce* examination, but made no definite recommendation. The Consultative Committee in its report says that there should be a *viva voce* examination. On this point, as on almost every point of our report, we are unanimous. We believe that qualities may be shown in a *viva voce* examination which cannot be tested by a written examination, and that those qualities should be useful to public servants. It is sometimes urged that a candidate—otherwise well qualified—may be prevented by nervousness from doing himself justice *viva voce*. We are not sure that such lack of nervous control is not in itself a serious defect, nor that the presence of mind and nervous equipoise which enable a candidate to marshal all his resources in such conditions is not a valuable quality. Further, there are undoubtedly some candidates who can never do themselves justice in written examinations, just as there are others who, under the excitement of written competition, do better than on ordinary occasions. We do not consider that it is desirable to forgo the *viva voce* test for the advantage of a few weak vessels. We consider that the *viva voce* can be made a test of the candidate's alertness, intelligence, and intellectual outlook, and as such is better than any other. The *viva voce* examination has been proved by experience to redress in certain cases the results of written examination. The examination should, of course, be skilfully conducted by carefully selected examiners accustomed

to handle young men and to put them at their ease. We consider that the *viva voce* examination should not be in matters of academic study, but in matters of general interest, on which every young man should have something to say. We think that the marks assigned under this heading should be a valuable corrective to the results of the written papers, and should not infrequently help a useful man to success or save the State from a bad bargain.

LIMITS OF AGE.—We propose no change in the limits of age, which are at present not less than twenty-two nor more than twenty-four on August 1 in the year in which the competition is held. Under existing practice the examination begins on August 1 or on August 2 if the 1st is a Sunday. We consider this time of year convenient for university candidates.

SCHEME OF EXAMINATION PROPOSED BY THE COMMITTEE.

SECTION A.

To be taken by all Candidates.

		Marks
1.	Essay	100
2.	English	100
3.	Questions on contemporary subjects, social, economic, and political	100
4.	Questions on general principles, methods, and applications of science	100
5.	Translation from one of the following languages not taken in Section B, viz. French, German, Spanish, Italian, Portuguese, Dutch, Norwegian, Swedish, Danish, Russian; Latin being also an option for those who take two modern languages in B	100
6.	A *viva voce* examination	300
	Total for Section A	800

This section is intended to test the candidates' knowledge of the English language and their capacity for its skilful use, their accurate command of knowledge which they should have acquired in the course of a systematic education and self-education, and should have retained to assist them in their future work, and their equipment in one foreign language at least for working purposes. The languages selected are those most likely to afford information useful to public servants. As circumstances change others should be added at the discretion of the Civil Service Commissioners.

The *viva voce* should be a test, by means of questions and conversation on matters of general interest, of the candidate's alertness, intelligence, and intellectual outlook, his personal qualities of mind and mental equipment.

It is not intended that any candidate should be disqualified for failure in any of the parts of this section or in the section as a whole, but that the section should count substantially in the competition.

SECTION B.

Optional Subjects.

Candidates to be allowed to take up subjects in this section up to a total of 1000 marks.

Languages with History and Literature.

		Marks
7.	Latin, translation, and prose or verse composition	200
8.	Roman history and Latin literature	200
9.	Greek, translation, and prose or verse composition	200
10.	Greek history and literature	200
11.	French, translation, free composition, set composition, and conversation	200
12.	French history and literature	200
13.	German, translation, free composition, set composition, and conversation	200
14.	German history and literature	200
15.	Spanish[1] or Italian,[1] translation, free composition, set composition, and conversation	200
16.	Spanish[1] or Italian[1] history and literature	200
17.	Russian,[1] translation, free composition, set composition, and conversation	200
18.	Russian[1] history and literature	200

The history and literature subject associated with each of these languages (7–18) can only be taken by candidates who also offer themselves for examination in the relevant language in Section B.

		Marks
19.	English literature, 1350–1700	200
20.	English literature, 1660–1914	200

History.

21.	English history to 1660, social, economic, political, constitutional	200
22.	British history, 1660–1914, social, economic, political, constitutional	200
23.	European history, 1494–1763	200
24.	European history, 1763–1914	200

Economics, Politics, Law, and Philosophy.

25.	General economics	200
26.	Economic history	100
27.	Public economics, including public finance	100
28.	Political theory	100
29.	Political organisation	100
30.	The Constitutional Law of the United Kingdom and of the British Empire, and the law of English local government	100
31.	English private law	200
32.	Roman law	100
33.	Public international law and international relations	100
34.	Moral philosophy	100
35.	Metaphysical philosophy	100
36.	Logic	100
37.	Psychology	100

Mathematics and Science.

38.	Mathematics, lower	400
39.	Mathematics, higher	400
40.	Astronomy	200
41.	Statistics	100
42.	Chemistry, lower	200
43.	Chemistry, higher	200
44.	Physics, lower	200
45.	Physics, higher	200
46.	Botany, lower	200
47.	Botany, higher	200
48.	Geology, lower	200
49.	Geology, higher	200
50.	Physiology, lower	200
51.	Physiology, higher	200
52.	Zoology, lower	200
53.	Zoology, higher	200
54.	Engineering	400
55.	Geography	200
56.	Physical anthropology, prehistoric archæology, and technology	100
57.	Social anthropology	100
58.	Agriculture	200
59.	Experimental psychology	100

[1] Papers on these languages should only be prepared on evidence presented one year in advance and satisfactory to the Civil Service Commissioners that at least one candidate will present himself who is likely to be fit for examination on a standard equivalent to those in French and German.

A candidate desiring to offer any of the subjects 42–54 or 59 must produce evidence satisfactory to the Commissioners of laboratory training in an institution of university rank. For (40) astronomy, (41) statistics, (55) geography, (56) physical anthropology, etc., and (58) agriculture, other equivalent training will be required. There will be no laboratory test as a part of the examination.

Extra Numerum.

Candidates may take, in addition to the above, one of the translation papers of Section A in a language not already taken by them in that section, not more than one of the Scandinavian languages, nor more than one of the three, Spanish, Italian, Portuguese, being offered by the same candidate; for this 100 marks will be awarded, not included in the 800 of Section A or the 1000 of Section B.

RADIO-ACTIVE HALOS.[1]

II.

WE shall now see that the thorium halo follows faithfully the same laws of development as the uranium halo, whatever we may assume as to the nature of these laws.

By plotting the seven α-ray curves of ionisation which must contribute to the formation of a halo in the medium surrounding a particle containing the parent element thorium, and then, as before, adding up the ordinates, we get for the total ionisation responsible for the thorium halo the next curve (Fig. 6).

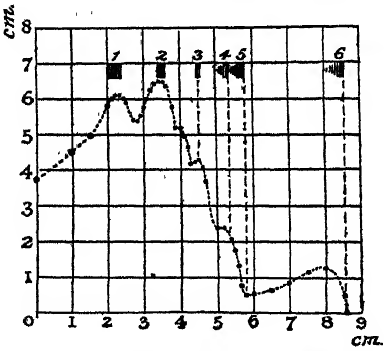

FIG. 6.—Integral curve for thorium halo.

Note that the single conspicuous maximum displayed by the corresponding curve for the uranium halo is now replaced by two maxima, the one which is nearer the centre being a little the lower. Beyond these two maxima the curve descends steeply with two excrescences before the minimum of ionisation is reached. Then the curve reascends to the low maximum due to ThC_1.

Now, the first beginning of the thorium halo shows two rings, and the radial dimensions of these rings are in good agreement with the positions of the two maxima of the curve. The inner ring has not been found alone. Next we find the space within and around these rings growing darker, accompanied by the early appearance of the outer ring due to ThC_1, just as in the case of the uranium halo we observe the early appearance of the ring due to RaC_1. The next stage, so far certainly observed, shows the loss of the internal features, the resulting halo exhibiting much the same appearance as the uranium halo in the final stage of development.

Above the ionisation curve for the thorium halo I have marked the several features of the halo. The agreement of the observed with the theoretical features is even closer than in the case of the uranium halo.

When we consider the successive steps in the genesis of the radio-active halo, which I have now laid before you, we can only come to the conclusion that some cause exists which tends to accentuate the effects going on in the outer regions of the halo. Could we assign a cause for the strengthening of the outer effects of ionisation, or, what comes to the same thing, for the weakening of the inner effects, every feature of the halo becomes explained by the curve of integral ionisation—that is, by the curve which simply sums the effects of the several Bragg curves. We would then find an explanation of the appearance of successive rings and of the appearance of the effects of the extreme or limiting ray at such an early stage of development.

If we assume that the process which results in the formation of a halo under the influence of the α ray is essentially similar in nature to that which is responsible for the photographic image under the stimulus of light, the desired explanation of the weakening of the inner features is forthcoming. For the phenomenon of reversal or of solarisation, well known to photographers, would assuredly lead to the weakening of the inner parts of the image. The repetition of stimuli at or near the same spot is necessarily more marked in the inner than in the outer parts of the halo, and the ionisation accumulating in the region traversed by the external limiting α rays is to a large extent exempt from the effects of repetition.

Now there are features in common between the halo image and the photographic image. Both are brought about by ionisation in a sensitive medium. There is so much indirect evidence for this view that we can scarcely doubt its truth. The salts of iron in many forms have been found to be photographically sensitive. In the photochemistry of chlorophyll they appear to play a fundamental part in Nature. Again, we may interpret the fact that the halo may be obliterated by heat, as proof of instability. Finally, the photographic plate is affected by the α ray in a manner not readily distinguished from that due to light.

Halos have been found which show all the appearance of reversal. In them we find the penumbra replaced by a band which is darker than the region lying within. Normal halos in its neighbourhood, by contrast, well show the peculiar change which affects the reversed halo. It is the negative of a halo. What is this appearance due to, if not to reversal? The effect must arise from very intense ionisation. The reversal has cleared the inner pupil more or less, but the repetition of stimuli has not been sufficient to affect the penumbra in the same manner. If these views are correct we may claim to know something of the nature of the phenomena which lead to the building up of the halo. We may regard the radio-active nucleus as emitting, for countless ages, radiations which slowly act, according to the laws affecting the latent photographic image, upon the surrounding medium. We must suppose the electric charge upon the α ray to affect the stability of the sensitive mineral, ionising the constituent atomic systems, and, finally, producing stresses and, possibly, displacements, which are revealed in the increased colour absorption.

Hitherto I have more especially dwelt upon the points of agreement between the observed and the theoretical halo. I venture to think that the agreement sets beyond any doubt not only the radio-active origin, but also the general mode of development of halos. I shall now refer to some details in which the observed halo is not in perfect agreement with the curve of ionisation.

In the case of the thorium halo the measured dimensions of the halo are in very perfect accord with the ionisation curve. The agreement seems generally as perfect as we could expect. There is, however, a very small appearance of misfit in the location of the first ring. The estimates I have made of the radius of

[1] Discourse delivered at the Royal Institution on Friday, May 11, by Prof. J. Joly, F.R.S. Continued from p. 458.

this first ring have consistently shown a small deficit. Small as it is, we should not ignore it. For there is some reason to suspect that our knowledge of the range of the α ray of thorium itself, which is largely responsible for the position of the first maximum upon the curve, is incomplete. The facts appear to show that the accepted range of the ray from thorium is too large. The evidence for this is both interesting and important.

Rutherford long ago pointed out that there appeared to exist a connection between the range of an α ray and the duration of life of the element from which it originates. The speed of the α particle seemed to be greater the shorter the period of transformation. Geiger and Nutall re-investigated the accepted ranges of the α rays of the radio-active elements, and established Rutherford's inference. Plotting the logarithms of the range and of the period of transformation against each other, they ascertained that for each family of elements there is a straight line along which the points found for the several α rays lie, and—in nearly every case—lie with astonishing accuracy. There is only one notable discrepancy. That exception is in the case of the range of the α ray from thorium itself. It is a few per cent. too great according to the observations. It is also, admittedly, the most difficult to measure with accuracy.

Translated into the distances obtaining in the halo, the few per cent. are almost beyond the limits of accuracy which may be fairly claimed. But the evidence for the slight misfit is based on many observations and may be significant.

In the case of the uranium halo there is also a discrepancy between the curve and the observations as regards the position of the first ring; but the magnitude of the discrepancy is more considerable than the misfit referred to above in the case of the thorium halo. And here we have no reason to throw the blame on any error in the accepted value of the ranges of the rays of U_1 and U_2. The curve of ionisation due to the α rays of these chemically inseparable elements has been investigated by Geiger and Nutall. The results obtained are explained on the assumption that U_1 has a range of 2·5 cm. and U_2 a range of 2·9 cm. in air. And these determinations accurately fit the logarithmic curve. The position of the maximum on the halo-ionisation curve is mainly determined by these results.

Careful measurements of the first ring of the uranium halo reveal this small but definite discordance between the radius of the ring and the position of the maximum of the curve. It will be seen that the section of the ring—the feature numbered 1 in Fig. 3—does not lie accurately above the centre of the maximum. The ring has a radius which is distinctly too great. That the ring essentially corresponds with the first great maximum of the curve seems beyond doubt. We find no other record of this maximum. There seems no apparent escape from the conclusion that the ring which is so largely due to the rays from U_1 and U_2 has been formed by rays of greater range than the average range of the rays now emitted by these elements.

The granite in which this halo-ring has been measured is very ancient, certainly not younger than the Devonian period. Similar rings, but not so sharp and easily measured, have been found in the Carboniferous granite of Cornwall. In younger granites I have not succeeded in finding them. It would be important to measure this ring in the younger granites, supposing they have been formed in these rocks. Such measurements would make quite clear whether or not the abnormal dimension of this first ring is really due to the former existence of a longer average range of the rays responsible. If the misfit of the first ring proves to be inexplicable in any deficiency of our knowledge of the ranges of the uranium isotopes, and especially if we are able, to get evidence that it is confined to the more ancient rocks, then it will be difficult to escape the direct conclusion that, however brought about, there was a former greater range of the α ray of the parent element of the uranium family.

There is a certain temptation to accept such a conclusion, for there is a strange contradiction in the evidence advanced for the duration of geological time. The conclusion that the halo reveals a former greater range for the α ray from U_1 carries with it the former more rapid decay of that element. All the difficulties and contradictions respecting the age vanish if this indeed occurred. It will only require a few words to state the present position of the matter.

From measurements of the rates of denudative processes at the earth's surface, and of the quantities accumulated, the evidence is, with wonderful consistency, in favour of a period of about 100 millions of years having elapsed since those processes came into existence. By making certain assumptions some 150 millions of years might be claimed, and even, not inconceivably, somewhat more. What other evidence have we? The only major limit which astronomy appears to give us would be in favour of an age even less than 100 millions of years. I refer to the duration of solar heat. It is quite certain that the earth was bathed in abundant sunshine even in Cambrian times; but solar heat of the present intensity cannot be accounted for on any known source of supply for 100 millions of years. From lunar theory we do not seem able to get a major limit. We must remember that we are not discussing the age of the earth as an astronomical unit. The geological age is the period of denudation only. Well, then, a generation ago very brilliant work was done by Kelvin on the period since the solidification of the surface rocks. But the thermal data involved became invalidated in the light of Strutt's discovery that heat-producing radio-active elements exist all over the earth's crust.

But if radio-active science in this way has closed one avenue of approach to the age problem, it has opened up another. Rutherford pointed out that the accumulation of radio-active products of decay in ancient rocks and minerals should afford a measure of the age in much the same manner as, from the amount of sand which has fallen through, we compute time by the hour-glass. In this connection Strutt's work on the amount of helium accumulated in materials of various geological ages will ever be memorable. The amount of accumulated lead, however, possesses, in some respects, less liability to error. The measurement of the ratio of the quantity of lead to the quantity of parent radio-active element in the case of uranium has occupied the attention of several investigators. The conclusion as regards the accumulation of lead in uranium-bearing minerals seems to be—although not without conflicting evidence—that the earth's geological age is not less than some 1500 millions of years.

Now, while we must admit the possibility of considerable variations in the rate of denudation over the past, yet the statement that the rivers are now pouring some ten times as much dissolved matter into, and transmitting some ten times as much sediment to, the ocean as they did in past times is, I think, quite inadmissible. All efforts to explain so extraordinary an increase—whether we suppose it to be temporary or permanent—have so far failed.

But the uranium series of radio-active elements is

not the only one available in the application of Rutherford's method of computing the age. There is quite as good evidence that the thorium series ends in an isotope of lead as there is for the same conclusion respecting the uranium series.

Now, in dealing with the atomic weight of the lead found in Ceylon thorite, Prof. Soddy recently carried out, on a large scale, a very careful chemical analysis of this mineral, and determined the quantity of lead present. When we calculate, on the basis of his results, the age of the mineral, we get about 140 millions of years. The rocks to which this determination applies are very ancient—certainly pre-Cambrian. The result is, therefore, in good agreement with the conclusion derived from denudation. Is this a mere coincidence?

Before this recent result it was known that the indications of thorium-derived lead were opposed to those of uranium-derived lead, and those who upheld the longer age urged that the lead derived from thorium must be unstable, and must turn into something else over geological time. But the view that thorium lead is not permanent is one beset with difficulties.

From this we see that the uranium and the thorium families of elements give, at the present time, contradictory evidence respecting the age of the earth. The latter apparently agrees in a remarkable manner with the indications of the surface changes of the globe; the former does not. And now the measurements of the uranium halo admit of the interpretation that they indicate the failure of uranium-derived lead as a true indicator of geological time. For if the range of U_1 was, indeed, in remote times longer than it now is, then we must suppose that its rate of decay was at that period faster than it is to-day. Or we may suppose that, however derived, in remote times relatively short-lived uranium isotopes existed which have died out during geological time. I am far from contending that this view is free from difficulties. On the other hand, our ignorance of the mode of origin of radio-activity and of its possibilities is very considerable.

If we have to admit that the evidence of the halo on the age problem is not yet complete, we can refer to a still more important matter upon which the testimony of the halo admits of no uncertainty. Until the radio-active origin of halos was ascertained it was impossible to pronounce on how far, in remote periods of earth-history, radio-activity might have affected the chemical elements. Thus it would have been a quite allowable speculation to suppose many of the elements to have been derived as end-products of radio-active families the activity of which has only comparatively recently become extinct. The halo enables a very general answer to be given to such speculations. A substance such as brown mica—and this is one of the most widely diffused of rock minerals—is sensitive to α radiation, and integrates its effects with the same certainty as the photosensitive plate integrates the effects of light. A mineral containing a minute trace of a radio-active substance beams, throughout the ages of geological time, upon the medium in which it is contained. If the medium is sensitive the accumulated effects in general persist for our inspection, and in the halo we are, in consequence, able to identify the presence of quantities of radio-active substances of almost inconceivable minuteness. Imagine that stellar magnitude which would be recorded upon a photographic plate exposed uninterruptedly for scores of millions of years!

We see from this that the *unaffected* plate of mica is evidence for the absence of even the feeblest α radiation from surrounding or included elements, just as the blank photosensitive plate is proof of the absence of luminous influence. No definite halo-producing effects have been observed other than those which may be referred to the known radio-active elements.

Thus we find that the study of the conditions which call the halo into existence affords a criterion for determining the absence of any general elemental evolution during the period of geological time. When geological time began any earlier evolutionary process must have already come to an end, with the sole exceptions of the known families of radio-active substances. This result, which is *a priori* by no means evident, is of importance to our views on the physical history of the earth. Only from the minute hieroglyphics we have been considering could such information have been derived.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Rhodes trustees have decided to make a grant of 1000*l.* towards the fund which is being raised for the endowment of a permanent professorship of forestry in the University, and the trustees of the University Endowment Fund are allowing the payment of 250*l.* per annum, which they have hitherto made towards the payment of an assistant professor, to be carried this year to the professorship of forestry fund.

A CHAIR of zoology has been established in the University of Manitoba, Winnipeg, and applications for the filling of it are invited.

THE following bequests have been made to American educational institutions by Col. O. H. Payne:—200,000*l.* each to Yale University and the New York Public Library; 100,000*l.* each to the Cornell University Medical College and Phillips Academy, Andover, Mass.; 40,000*l.* each to Hamilton College, Clinton, N.Y., and the University of Virginia.

THE Ellen Richards research prize, value 200*l.*, is offered by the Naples Table Association for Promoting Laboratory Research by Women for the best thesis written by an American woman embodying new observations and new conclusions based on independent laboratory research in biology (including psychology), chemistry, or physics. The competing essays must be received before February 25 next. Application forms are obtainable from Mrs. A. W. Mead, 823 Wayland Avenue, Providence, R.I., U.S.A.

LORD HALDANE presided at a meeting of University Extension students at Oxford on August 6, and delivered an address in which he urged that in education, as in most other things, unless we have a devolution of powers to those who are able and willing to do the work in the various localities, we shall not make very much progress. He suggested the inauguration of from seven to ten educational provinces in Great Britain. The general object should be to break down the gulf between elementary and post-elementary education. They should be unified into one great organic whole of national education, and the universities should exert a permeating influence in every province—no province without a university at one extreme, and representatives of the local education authority at the other. The best men in the locality should be co-opted on the provincial councils, and the teachers, secondary and elementary, should also have an important place on them. The Board of Education should give as much latitude as possible to the provincial authorities. If we can get rid of the network of rigid regulations, we shall have got a great deal done.

ONE of the most important changes which the war has brought about in our educational institutions has been the rapid conversion of the engineering laboratories of our universities, colleges, and schools into training centres for munition-makers or into munition works. The number of those trained who are now doing work of national importance must be very large. According to a report of the Education Committee of the London County Council the institutions under its control train 3000 per annum, while the output of gauges from the institutions employed in their manufacture exceeds 30,000 per annum. Between one and two hundred woodwork instructors in the employ of the council have become proficient in metalwork, and the remarkable results which have been obtained by sending men and women without any previous experience of metalworking through a five or six weeks' training have taught the committee the desirability of devoting much more attention to instruction in workshop processes and production in educational institutions after the war. Hitherto such training has been left to the factories, but recent experience has shown that it ought to form a more intimate part of the work of the technical schools. It is of importance to ascertain to what extent the experience of authorities in other parts of the country agrees with that of London.

WE have received from Delhi a copy of the report of a conference held in January last of the directors of public instruction for the various provinces of India (see NATURE, March 8, p. 38). The conference was opened by the Viceroy, Lord Chelmsford, who, in the course of his inaugural address, urged the directors in their work of developing technical education in India not to overlook the claims of agricultural and commercial education. He said the great advance made by scientific agriculture during the last half century justifies us in pressing forward with a policy of agricultural education in India, and though the directors would not claim to speak as experts on the agricultural side, their educational experience qualifies them to give useful hints with regard to an advance along this road. Again, on the commercial side of education, he expressed surprise to find how little has been done in spite of India's large and growing commerce. Compared with a technical institution, a commercial school is a relatively cheap institution, and one would think that there was a great opening in the big towns of India for good commercial schools. In technical training in its narrower sense he said sight must not be lost of workshop practice in outside works. Laboratory training, however good, is no real substitute for the discipline of the workshop. The directors discussed, among other subjects, the teaching of science in the secondary schools of India. It appears that in the higher classes of Madras schools elementary science is obligatory. In Bombay science is compulsory in Government high schools, and the University demands a study of science from matriculation candidates, though it conducts no examination in science at this stage. In the provinces which come under the Calcutta matriculation the position of science teaching is not satisfactory. In Bengal there is practically no science teaching whatever in schools for Indian pupils. One of the optional subjects for the matriculation examination is elementary mechanics, but very few candidates offer this subject. Geography is also an optional subject for matriculation. Otherwise, no provision whatever is made in the Calcutta University matriculation for the teaching of science. Looking to the peculiar difficulties which underlie the educational problem in Bengal, it was thought practical science should be made obligatory and be included in the school-leaving certificate.

THE Association of Headmasters, which, it will be remembered, is concerned with secondary education, has adopted and circulated an "educational policy" which may be taken to embody the considered opinion of the headmasters of the secondary schools in this country as to what are desirable educational changes to meet the conditions which will follow the declaration of peace. Their policy insists, among other points, that elementary education should be considered as a preliminary or preparatory stage. It is not yet possible to require that no one shall be allowed to leave school in order to earn money before the age of eighteen; but it is possible to provide that no child's education shall wholly cease on its leaving the elementary school, and that up to the age of eighteen education shall never be wholly subordinated to the ability to earn wages. There must be a considerable increase (1) in the number of secondary schools—*i.e.* schools which provide some form of whole-time general education as distinct from technical training up to the age of eighteen, and (2) in facilities for part-time education. The chief needs in respect of secondary education enumerated by the policy are:—(*a*) More extensive and more varied provision for children capable of profiting by a definite course of education up to the age of eighteen. (*b*) The encouragement and assistance of a much larger number of children to take full advantage of such provision. This involves the lengthening of school life by means of (1) the provision of adequate scholarships and maintenance allowances; (2) the requirement that all pupils who enter a secondary school shall continue in attendance at some such school until the age of sixteen. (*c*) As in the case of elementary schools, the expenditure of much more money in attracting competent persons into the teaching profession. With reference to the curriculum it is stated that one of the most serious dangers to secondary education lies in the overcrowding of the time-table through the conflicting demands of an ever-increasing number of subjects. In framing curricula the first consideration should be to guard against this overcrowding, and to ensure that sufficient time is available for the adequate treatment of the subjects which are taught. No boy should be allowed to specialise until he has attained a satisfactory standard of general education. This standard should be that which a boy of ordinary ability may be expected to reach at the age of sixteen. The subjects of a general education should include as a rule Scripture, English, history, geography, mathematics, science, and ordinarily two languages other than the pupil's own—in most cases these should be French and Latin.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 9.—M. Ed. Perrier in the chair.—L. **Maquenne** and E. **Demoussy**: The influence of mineral matter on the germination of peas. Peas have been germinated in sand moistened with distilled water containing varying known amounts of metallic salts and the length of the roots measured after six days' germination. Twelve metals were used in these experiments, details being given of the results obtained with each one. Calcium would appear to be the only element which, in the absence of any other, is capable of producing normal germination, and the amounts required are extraordinarily small. The growth of the stem will be the object of further researches.—E. **Ariès**: The sign of the specific heat of saturated vapour in the neighbourhood of the critical state.—A. **Thybaut**: Tautochrone curves.—G. L. le **Cocq**: All known systems of hyperstatic suspension bridges are

derivatives of isostatic suspension bridges, and the latter are only particular cases of one single and unique system which includes all.—M. **Siegbahn**: High-frequency spectra. Some of the work recently published by MM. R. Ledoux-Lebard and A. Dauvillier has been anticipated by the author and E. Friman (*Phil. Mag.*, July, 1916).—P. **Chevenard**: The mechanism of the tempering of carbon steels. The results of the experiments described completely confirm the conclusions recently published by MM. Portevin and Garvin.—A. **Portevin**: The manganese steels. The steels were submitted to very slow cooling, seventy-five hours in cooling from 1300° to 100° C. The results, given in detail, differ considerably from the effect of a normal annealing (three to five hours from 1000° C.).—E. **Urbain**: A method of determining molecular weights. The method is based on determinations of the boiling point of a mixture of the liquid the molecular weight of which is to be measured with a non-miscible liquid, such as water, and the composition of the distillate. Examples are given of the measurement of the molecular weights by this method of benzene, carbon tetrachloride, and limonene.—Mlle. Y. **Dehorne**: The presence of the genus Stromatoporella in the Senonian in the neighbourhood of Martigues (Bouches-du-Rhône).—L. **Bordas**: The egg deposition of *Rhynchites conicus* and the anatomy of its larva. This parasite has caused great damage to apple, pear, cherry, and peach trees in Rennes and its neighbourhood.—A. **Compton**: Cerebrospinal meningitis and meteorology

July 16.—M. Camille Jordan in the chair.—A. **Lacroix**: The felspathic ortho-amphibolites and orthopyroxenites of Madagascar.—G. **Bigourdan**: A gardener-astronomer of the seventeenth century, Elzéar Féronce: Calignon de Peyrins and the reciprocation of the pendulum.—G. **Gouy**: Interferences with large differences of path.—G. A. **Boulenger**: The evolution of the poison apparatus of snakes. Remarks on a recent communication of Mme. Marie Phisalix.—J. **Priwaloff**: The convergence of conjugated trigonometrical series.—E. **Vessiot**: The canonical equations and developments in series of celestial mechanics.—M. **Amsler**: The development in a continued fraction of a quadratic irrational.—V. M. **Hegly**: Flow over a weir in a free sheet with lateral contraction.—MM. **Luizet** and **Guillaume**: Occultations observed during the total eclipse of the moon of July 4, 1917, at the Lyons Observatory.—St. **Procopiu**: Induction apparatus for detecting projectiles in wounds. A modification of the Hughes induction balance in which a galvanometer replaces the telephone. The deviations of the galvanometer vary with the distance of the projectile from the surface.—A. **Colani**: Study of the system water, uranyl oxalate, sodium oxalate.—A. **Pictet**, O. **Kaiser**, and A. **Labouchère**: The alcohols and bases of vacuum tar. Six alcohols and six bases were isolated. The alcohol of lowest boiling point was proved to be *p*-methyl*cyclo*hexanol (hexahydro-*p*-cresol). The other alcohols were not identified, but belong to the hydroaromatic series. It is probable that these alcohols exist in the coal, since the benzene extract contains these alcohols in practically the same proportions as the vacuum tar.—Em. **Saillard**: The action of acids on the rotatory power of saccharose and invert-sugar in the presence of soluble salts.—F. X. **Skupienski**: Sexuality in the Myxomycetes group of fungi.—Mme. M. **Phisalix**: The subjective value of the evolution of the poison apparatus of snakes and the physiological action of the poisons in systematic classification.—MM. **Denier** and **Vernet**: The bacteriological study of the natural coagulation of the latex of *Hevea brasiliensis*.—A. **Policard** and B. **Desplas**: The histological mechanism of granulation of wounds in man.

BOOKS RECEIVED.

Scientific Treatise on Smoke Abatement. By H. Hamilton. Pp. xiii+155. (Manchester: Sherratt and Hughes.) 5*s*. net.

History of the Spanish Conquest of Yucatan and of the Itzas. By P. A. Means. Pp. xv+206+plates. (Cambridge, Mass.: The Peabody Museum.)

Notes on the Order of my Categories and Alphabet. By R. E. Dennett. Pp. 18. (Lagos: Government Printer.)

The African Table of Periodic Law. By R. E. Dennett. Pp. 12. (Lagos: Government Printer.)

Studies in Psychology. Contributed by Colleagues and Former Students of E. Bradford Titchener. Pp. 337. (Worcester, Mass.: L. N. Wilson.)

Results of Atmospheric-Electric Observations made Aboard the *Galilee* (1907–8) and the *Carnegie* (1909–16). By L. A. Bauer and W. F. G. Swann. (Washington: Carnegie Institution.)

The Magnetic Work of the *Galilee*. By L. A. Bauer, W. J. Peters, and J. A. Fleming. (Washington: Carnegie Institution.)

The Magnetic Work of the *Carnegie* (1909–16). By L. A. Bauer, W. J. Peters, J. P. Ault, and J. A. Fleming. Some Discussions of the Ocean Magnetic Work (1905–16). By L. A. Bauer and W. J. Peters. (Washington: Carnegie Institution.)

A Class-Book of Organic Chemistry. By Prof. J. B. Cohen. Pp. viii+344. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

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THURSDAY, AUGUST 16, 1917.

AVIATION AND AIR-POWER.

(1) *Air-Power: Naval, Military, Commercial.* By C. Grahame-White and H. Harper. Pp. viii+262. (London: Chapman and Hall, Ltd., 1917.) Price 7s. 6d. net.

(2) *The Aviation Pocket-book for 1917: A Compendium of Modern Practice and a Collection of Useful Notes, Formulae, Rules, Tables, and Data Relating to Aeronautics.* By R. B. Matthews. Fifth edition. Pp. xix+300. (London: Crosby Lockwood and Son, 1917.) Price 4s. 6d. net.

(3) *The Properties of Aerofoils and Aerodynamic Bodies: A Text-book for Aeronautical Engineers, Draughtsmen, and Students.* By A. W. Judge. Pp. x+298. (London: Whittaker and Co., 1917.) Price 15s. net.

(1) "AIR-POWER" is a non-technical survey of the position of aviation and its future, both in the military and civil senses. The book raises political as well as technical issues, and in the preface says that dominion of the air must mean ultimately the dominion of the world. Naturally enough, we find that Britain is to lead the world, but on the whole the book depends for its subject-matter on the ideas and propositions now well known in aeronautical technical circles, and the dominion looked for appears to be in the arts of peace rather than in those of war.

The book adds one more to the number of well-deserved tributes to the prowess of the British pilot during the war, and voices a fairly generally held opinion that natural aptitude for flying is a great and characteristic asset of the nation. It should not be forgotten that the war provides an outlet for sporting instincts which will be absent from the more humdrum work of the civil pilot, and the genius of the Germans for the organisation of humdrum labour should not be lost sight of in our efforts to avoid the suppression of individuality. The authors point out that in the present war the Germans reaped an initial advantage from the use of large numbers of mediocre aeroplanes, the organisation of the Allies for obtaining air supremacy being said to have been ineffective until the summer of 1916.

In future wars the authors foresee huge raiding expeditions by aeroplanes, the airship being heavily discounted by reason of its vulnerability to attack. On the other hand, aeroplanes are relatively safe from land-fire, although the proportion of machines brought down in this way is steadily increasing. During raids each bombing squadron is to be escorted by faster machines of a fighting class, whilst for long expeditions means will have to be discovered of keeping formation, the tendency being for units to separate and lose contact, thus rendering themselves more liable to attack from the opposing aircraft.

As a result of these bombing tactics we are to be driven underground. Arsenals, Government buildings, and factories of national importance are all to hide their diminished heads.

It is to be hoped that the aeroplane will not be such a terrible weapon of offence as is portrayed by the writers of "Air-Power." Fortunately, the discussion of the technical details of the future aeroplane gives hope for a reasonably lengthy period in which to adjust ourselves to the new world that is to be.

The future aeroplane is to travel at 200, 250, or even 300 miles an hour, and to accomplish this with safety the area of the wings is to be variable to a great extent between high speed and cruising speed. They are to have petrol turbines instead of the present reciprocating engines; many of them may be used in one aeroplane, which will probably be a multiplane. There is to be a Transatlantic service doing the journey in forty-eight hours, and air travel is to be the ideal form of touring, because there will be no dust and no petrol fumes, apparently not even from the turbines. With such a machine it is surprising to find that the authors are doubtful of their pilots, and say that careless pilots must not on any account be allowed to take charge of machines, or the public might get timid.

The programme outlined is scarcely ever outside the bounds of possibility, but views on aviation will have changed greatly long before the programme is completed. If the authors do not convey their full enthusiasm to their readers, it is hoped that they are helping to make known the growing conviction that aeronautics is going to take a not unimportant place in the future history of the nation.

(2) Engineering pocket-books, no matter what the branch dealt with, must contain a certain amount of common matter, and in the case of the aviation pocket-book the formulæ for the strength of struts and beams and the permissible loading of ball-bearings are instances of this common grounding. The specialised part of pocket-books comes from the standard text-books of the branch, and in aviation these books are still in the early stages of development. The formulæ and tables of the pocket-book are correspondingly meagre.

The aerodynamical information with which the book opens is correct enough, so far as it goes, but one may doubt its assistance to designers, who have much more recent and complete information at their disposal. On the subject of stability the book is very weak, and the brief note on lateral stability is valueless.

The author has given the method and formulæ used in the design offices when devising propellers, and as these are of a standard type the pocket-book will form a source of handy reference. It is probable that in the near future the theory will be extended, but not superseded. Engines are described mainly by the reproduction of the reports of trials, but some of the notes on tuning and engine faults are taken from the older subject of motoring, and should provide valuable assistance to those concerned in the use of aeronautical engines.

There are many other interesting features in the pocket-book, amongst which may be mentioned the tables of meteorological data, a description of compass errors and their elimination, scouting and signalling, a glossary of aeronautical terms, and a bibliography of aeronautics. The pocket-book makes a good beginning at collecting the skeleton tables and formulæ of the aeronautical industry, and may be expected to grow and keep pace with the text-books of the day.

(3) This book, one of a series of four contemplated by the author, consists of a collection of papers from various sources, of which the most prominent are the aerodynamical laboratories at the National Physical Laboratory and at Auteuil. The collection is uncritical, and in some cases the author is out of his depth. This is the case in the discussion of dynamical similarity, and more generally on all the theoretical topics dealt with in the book.

Aeronautics is still so new that work only three or four years old may need modification in the light of more recent experience before it can be used safely in a general scheme which includes this later work. It is the absence of these modifications which renders the book very little better than the original papers, and only so far as it leads to a wider distribution of knowledge has it any value.

The author limits the scope of his book to that part of aerodynamics which refers specifically to the performance of an aeroplane, and leaves to a separate volume the aerodynamical data which are concerned in the discussion of stability and control. It is clear that the author is handicapped by the restrictions which war places on publication, and considerable revision and addition may be expected at the end of hostilities.

THE GLASTONBURY LAKE VILLAGE.

The Glastonbury Lake Village: A Full Description of the Excavations and the Relics Discovered, 1892–1907. By A. Bulleid and H. St. George Gray. Vol. ii. Pp. xxxv–xl + 353–724 + plates lix–ci. (Glastonbury Antiquarian Society, 1917.) Price, 2 vols., 3*l*. 3*s*. net.

THIS volume completes the record of one of the most important excavations which have recently been carried out in this country. It falls into two parts: first, a descriptive catalogue of the objects discovered in the course of the excavation, prepared by a competent archæologist, Mr. St. George Gray, who was trained in the new school of archæological work under General Pitt Rivers, the pioneer in scientific processes of excavation; secondly, articles on plants, wild and cultivated, by Mr. Clement Reid; on the remains of birds, by Mr. C. W. Andrews; and an important series of papers by Prof. Boyd Dawkins on wild and domesticated animals, the inhabitants of the village, the range of the Iberic race in the prehistoric Iron age, and the place of that race in British ethnology.

The catalogue prepared by Mr. St. George Gray is a good piece of ethnographical work, each specimen being carefully described with a lavish display of illustrations. Indeed, it is more than a mere catalogue; it might be better described as a handbook for the archæologist, because he not only describes the specimens with which he is dealing, but compares each article with similar objects found elsewhere, and gives careful references to a large number of papers in scientific journals. It might be worth considering whether this part of the book might be reprinted in a cheaper form for the use of field workers.

In order to complete the survey of this interesting site it may be hoped that the chance of recovering the village burial-ground will not be overlooked. In its absence some important questions must remain unanswered. In Britain during the prehistoric Iron age inhumation and cremation were both recognised methods for the disposal of the dead. This was probably the case in Glastonbury, and though a good deal of pottery has been recovered, it is as yet impossible to say how much of it may have been used for funerary purposes.

The valuable series of papers contributed by Prof. Boyd Dawkins enables us to understand the physical types of the people, their connection with other races, and in some measure, with the help of the articles found on the site, to reconstruct their local culture. From the sporadic distribution of the human bones, as well as their general isolation, he believes that we must suppose that a general massacre of the inhabitants occurred, and this conclusion is amply supported by marks of violence found on some of the skulls. Like their neighbours, they seem to have been subject to Belgic tribes which at the time of the Roman conquest had become the dominant power in southern Britain. The Lake-village was probably stormed and sacked by some Belgic tribesmen when they took possession of Somerset some time between Cæsar's invasion and the Claudian conquest. As M. Salomon Reinach has shown in the case of some of the Celts of Gaul, these Belgæ were possibly head-hunters, and a weak settlement like this would be likely to provoke attack. In other places, like Wookey Hole and Worlebury, some survivors returned and reoccupied their houses. But at Glastonbury the whole population may have been wiped out or enslaved, and the site has remained uninhabited down to the present day. Possibly they were too weak to make effective resistance. The scarcity of weapons, even among people occupied in pastoral and industrial pursuits, is striking; out of 107 objects of iron, only seven could be classed in this category. At the same time, though sporadic fires used to occur, there seems to have been no general conflagration.

As regards the racial affinities of the inhabitants, they were members of the Iberic stock, the oldest element as yet traced in the existing European peoples. They were closely connected with their neighbours, the Silures, and probably they lost their Iberic tongue when they passed under the rule of the Goidels, and learned, in the Bronze age, to speak Gaelic. This Gaelic tongue was in its turn replaced by the Brythonic—Welsh,

Cornish, Breton—when the Brythons ruled the land in the prehistoric Iron age. Neither the Belgic nor the Roman conquest left any physical marks on this isolated community, hidden away in the marshes.

The best way of understanding their mode of life is by a comparison with that of the inhabitants of other similar settlements. The Worlebury folk, their neighbours, were in the same stage of culture as the Lake-villagers: practised the same arts—spinning, weaving, pottery-making; grew the same wheat, barley, and beans; had the same domestic animals, and lived in the same sort of huts, with this difference, that at Worlebury the huts were sunk in the ground, instead of being supported by artificial foundations in a marsh, and they were protected from attack by massive stone walls, instead of palisades.

We have said enough to indicate the value of this elaborate survey of an interesting, isolated prehistoric community, on which the Glastonbury Antiquarian Society and the editors, Dr. A. Bulleid and Mr. St. George Gray, are to be congratulated.

MECHANICS AND METALLURGY.

(1) *Guida Pratica del Meccanico Moderno.* By Arturo Massenz. (Manuali Hoepli.) Pp. xxiv+351. (Milano: Ulrico Hoepli, 1917.) Price 4.50 lire.

(2) *Tempera e Cementazione dell' Acciaio.* By Mario Levi-Malvano. (Manuali Hoepli.) Pp. xii+261. (Milano: Ulrico Hoepli, 1917.) Price 4 lire.

(1) THE present volume forms one of the excellent series of which Messrs. Hoepli have now published some 600, dealing with the arts and sciences. This work is intended chiefly for foremen and for students of technical and industrial schools who are about to start their works career. Brief descriptions are given of the various small tools and appliances met with in a modern shop, with particulars of the operations for which they are intended. The text and illustrations are suggestive rather than fully explanatory, though a series of exercises accompanies each chapter, thus permitting the student to follow what he reads. Simple mathematics are introduced where necessary to elucidate any particular point. The heat treatment which metals necessarily undergo in the course of working is explained. The book concludes with an exposition of the different systems of screw-threads and of the uses of the various machine-tools.

(2) This volume attempts to give in a small compass a comprehensive account of the hardening of steel for industrial purposes. It is a thoroughly up-to-date little manual, being entirely rewritten from an earlier work published by the same firm. The first part of the work is devoted to theoretical metallurgy—the constitution of iron, the iron-carbon system, effects of heat treatment and mechanical treatment on the structure of steels, etc.—and mentions the work that has been done on the subject by the leading European metallurgists during the last twelve years or so. In the practical part the various operations of hardening and cementation are described, together with the furnaces used, while the methods of temperature measurement—Seger cone, Féry thermocouple and pyrometer, etc.—are touched on. As an introduction to some larger work on the subject this handbook can be warmly recommended to readers who have attained to some fluency in Italian. The book is well illustrated and printed, and in a form convenient for the pocket. E. S. H.

OUR BOOKSHELF.

Experimental Building Science. By J. Leask Manson. Pp. vii+210. (Cambridge: At the University Press, 1917.) Price 6s. net.

THIS book is an indication of the more intimate relations which are growing up between pure science and industry, and provides a course of simple experimental work which should be within the reach of students destined to become responsible for the manifold operations comprised under the term "building construction." The author explains the fundamental laws of physics and chemistry, and draws upon building materials and the everyday devices employed in buildings for his illustrations of these laws. The underlying principles, as he points out, are necessarily devoid of any novelty, but the practical illustrations are numerous and well chosen. Starting with an explanation of density and of water and air pressure exemplified by reference to water supply and drainage problems, the structure of materials is next shortly dealt with, and then the application of force, which section includes some useful spring balance experiments. The physical section concludes with some account of heat, and the last third of the book is devoted to elementary chemistry. The diagrammatic figures are very fully "written up," which should help the student. Partly a text-book, partly a laboratory manual also supplied with test questions, the book is capable of a wide application, and should prove useful to the enlightened student of building who realises that if he is to maintain his position in later life he must at least know something of the fundamental laws of natural science as applied to his work.

Treatise on Hydraulics. By M. Merriman. Tenth edition, revised with the assistance of T. Merriman. Pp. x+565. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 18s. 6d. net.

SINCE the first publication of this book in 1889 there have been many notable advances in hydraulics. The eighth edition was entirely rewritten, the ninth (1911) reset, and the present edition contains supplementary sections which bring the volume up to date. General principles are treated in the first three chapters; the flow through orifices, over weirs, through tubes, pipes, and conduits, together with the flow of rivers,

are dealt with in chaps. v. to x. The work done on vanes, and water-wheels and turbines take up the following three chapters, and the book closes with chapters on naval hydromechanics, pumps and pumping. The space devoted to the flow of water is large by comparison, and includes, in addition to the usual subjects, the flow through fire-hose and in fountains. Biel's formula for the flow in pipes and channels is discussed, and results calculated from it are compared with those given by Kutter's formula. The treatment of this section is adequate and good.

The book contains many illustrations, mostly outline diagrams, and while these illustrate very well the principles discussed, the inclusion of a larger number of working drawings would have been better. This remark applies particularly to the sections dealing respectively with turbines and pumps; the latter has no working drawings whatever, and both sections could bear considerable expansion. Hydraulic machinery is dismissed in three and a half pages, with four inadequate sketches, regarded from the point of view of the student who desires to know how the appliances are actually constructed.

Throughout the entire volume there are copious references to articles in periodicals, other books, transactions of societies, etc.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Plea for the Fuller Utilisation of Coal.

THE suggestion in your article of July 26 on the Fuel Research Board of "the employment of coke-oven gas to supplement the output of suitably situated gas works, and the more extended use of water-gas," is timely, and it certainly does not err on the side of excess.

As pointed out in a paper which I read before Section G of the British Association in 1906, "if all the foundry coke which is used in this country were made in by-product recovery ovens, the resulting yield of gas would be more than 160,000,000,000 cub. ft. per annum, or *more than is used in one year in the whole of the United Kingdom*"; and, as regards the distance to which the gas might be conveyed, it is scarcely an exaggeration to say that the economic limit of supply is the coast-line of Great Britain.

The possibility of conveying gas over long distances is scarcely realised in this country, although in the United States gas has for many years past been piped at high pressures over hundreds of miles.

The need for a cheap supply of power is beginning to make itself felt. Not unnaturally we turn to electricity; but over long distances gas is a very formidable competitor.

The question of fertilisers is also attracting attention. For years past we have been spending something like 15,000,000*l.* per annum on importing nitrate of soda from Chile, and wasting an equivalent amount of nitrogen by our primitive methods of using coal.

We are beginning, too, to realise the importance of the great coal-tar industry which we have allowed to slip into German hands.

In every direction we are confronted by problems which depend for their solution on a fuller utilisation of our great national asset.

The burning of coal in its raw state was long ago denounced by the late Sir William Siemens as "a barbarous practice"; but habit is strong, and our business men have been too busy making money to give much thought to economy in power production.

Recent events have violently jolted us out of our ancient grooves, and there is now a disposition to consider novel proposals on their merits.

I showed in a paper read before the Society of Arts in March, 1906, that coal-gas made at the pit's mouth could be delivered in London at a price at which it would oust coal from the home and from many industrial processes. My proposals may be briefly summarised as follows:—

(1) The whole of the coke-oven gas now wasted would be utilised, and a part of the additional gas required generated from small coal at the pit's mouth by the ordinary method of carbonisation, but without regard to illuminating power.

(2) The waste heat from the retorts would be utilised to raise steam for compressing the gas.

(3) The exhaust steam would be used to generate water-gas.

(4) The gas would be piped to wherever required, and delivered under sufficient pressure to charge the storage cylinders of motor vehicles.

(5) Chemical works would be established near the collieries to deal with the ammonia, tar, etc.

In this way practically the whole of the available heat of the coal would be turned to account, instead of wasting some 90 per cent. of it, as is done in generating electricity by steam-power; and the residuals, the whole of which are wasted when coal is burnt under a boiler, would be turned to good account.

The question bristles with points of scientific interest, but I have already trespassed long enough on your space and on the patience of your readers.

ARTHUR J. MARTIN.

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Devitrification of Quartz Glass.

IN an article by Audley, published in the Transactions of the Ceramic Society, vol. xvi., part i., p. 124, it is stated that the addition of zirconia to fused quartz gives a product resembling quartz opaque glass, but in many respects superior to quartz glass, and less easily devitrified.

The statement is repeated in the article on the uses of zirconia in the issue of NATURE of July 5, and had previously found its way into much of the literature dealing with quartz glass. The alleged superiority of quartz glasses containing zirconium or titanium oxides is due to some experiments carried out by Thomas in the laboratory of Borchers at Aachen, and published in the *Chemiker Zeitung* in 1912. These experiments were shown by me (*Chem. Zeit.*, 1913, p. 589), and independently by others, to be untrustworthy, quartz glasses containing zirconium and titanium oxides being, in fact, more liable to devitrification than quartz glass prepared from pure silica. The purer the quartz glass is the less is its tendency to devitrify after prolonged exposure to heat. Quartz glass manufacturers in this country are well aware of this, and endeavour to produce a material as free as possible from all impurities.

A. C. MICHIE.

The Wallsend Laboratories,
Wallsend-on-Tyne, August 7.

THE REVISION OF THE CIVIL SERVICE EXAMINATIONS.

THE committee appointed by the Lords Commissioners of H.M. Treasury to consider and report upon the scheme of examination for Class I. of the Civil Service has reported under date June 20, 1917 [Cd. 8657]. It gives, in the first place, an historical summary showing the variations in the scheme first adopted when the principle of open competition came into effect in May, 1855. With its apologia for the predominance given to classics we need not concern ourselves in view of the amendments it proposes.

The revised scheme which it outlines provides for examination in two sets of the subjects. First, a compulsory set, including an essay, and papers on English, contemporary questions, general scientific principles and methods, and translation from one modern language (or from Latin, if desired by modern language students); to each of these 100 marks is assigned. There is also a compulsory *vivâ voce* examination to test alertness and intelligence; to this 300 marks are assigned. All this seems very reasonable.

The second set of subjects is optional; candidates may offer (*a*) languages; (*b*) history; (*c*) economics, law, etc.; (*d*) mathematics and science; and (*e*) an additional translation paper in a modern language.

For the first time the modern languages are placed on a par with Latin and Greek, 200 marks being assigned for translation, etc., and 200 for the history and literature of the country in each case.

Mathematics gets its proper place; 800 marks are assigned to the subject—400 for lower and higher mathematics respectively. Science also is similarly treated, the marks, *e.g.*, for physics being equal to those obtainable for Latin, viz. 400. Engineering is, for the first time, brought within the scope of the examination and may also earn 400 marks. Another important new subject is statistics, which is valued at 100 marks.

Candidates offering science subjects are very rightly required to produce evidence that they have received laboratory training in an institution of university rank; but there is, of course, to be no laboratory test in the examination itself.

On the whole the scheme may be regarded as quite satisfactory; it provides opportunities for men trained efficiently on varied lines to gain access to the important posts to which these examinations ultimately lead; and it will now be the fault of the provincial universities if their *alumni* are not found among those who serve the State in this way. And after the scheme has been in operation for some years there should be in the higher ranks a fair proportion of men who have had a good scientific training, while the remainder will not suffer from that complete ignorance of scientific principles and methods which characterises most of our existing mandarins.

Of course, the new scheme will not alter the deplorable system by which service in those departments of the public service not open to public competition are chosen so very largely from the ranks of classical scholars. It may still be possible, *e.g.*, for an authority on medieval English literature to be primarily responsible for technical education and for there to be no representative of scientific knowledge, training, and education among the highest officials of the Board of Education or among the chief administrators of the funds devoted to scientific and industrial research.

In an appendix to the report specimen papers are set forth. The one in general science (for *all* candidates) is interesting and on the right lines; it asks for just that amount of general scientific knowledge likely to benefit all public servants; and a wide choice is to be allowed. Quality in the answers is to be sufficient, and accuracy of statement and clearness of expression are to be essentials.

The compulsory paper on social, political, and economic subjects is also on the right lines; it requires a candidate to have some clear ideas as to the way we are governed and as to the questions underlying the proper conduct and development of our trade and commerce.

The age limits for candidates remain as at present—twenty-two to twenty-four. This will prejudice candidates from the provincial universities; but if it helps to lead to a later age of entry and to make the requirement of a four years' course for an honours degree more general, it will have done useful work. The provincial universities would do well to combine to fix their minimum age of entry at eighteen, with a standard of educational efficiency equal to that required from present candidates for the intermediate examination for the initial degrees.

The committee has done valuable work, and we may be sure that the experience and advice of the two fellows of the Royal Society who were members of it—Sir Alfred Ewing and Sir Henry Miers—have contributed in no small degree to the wise decisions which have been taken.

J. WERTHEIMER.

THE NEW EDUCATION BILL.

MR. FISHER introduced the long-expected Education Bill in the House of Commons on August 10, and it was read a first time. The reforms which the Bill outlines have long been overdue, but they have been delayed by the exigencies of our system of government, with the importance it has attached to the claims of the different political parties, which have year after year placed at the head of the Board of Education Ministers with no knowledge of the educational needs of the country, little appreciation of the intimate connection between educational efficiency and industrial and mercantile supremacy, and chiefly concerned with securing advantages for the party to which they owed their position. But in Mr. Fisher we have a Minister of Education who is an educationist conversant with every grade of our educational system and dominated by the idea that "education is one of

the good things of life, which should be more widely shared than has hitherto been the case amongst the children and young persons of the country "—to quote his own words. If his Bill eventually becomes an Act embodying the reforms he described in his introductory speech, it will mark a turning-point in English education and will place the nation firmly on the road leading eventually to real educational efficiency.

But the Bill is at its best only an instalment of what is wanted and what must be secured if our educational system is to be complete. As Mr. Fisher explained in his speech, the Bill does not affect the government of the universities, or of those institutions of secondary, technical, and other higher forms of education which are not maintained or aided by local education authorities. It does not deal with the scholarship system, the training colleges, or libraries, and the establishment of a satisfactory pensions scheme for teachers in secondary, technical, and other schools at present outside the State scheme of pensions. These pressing matters are, we are told, to be included in separate measures, but in view of the demands which the war must continue to make on the Government and the House of Commons, it is difficult to be optimistic as to the chances of early legislation in the direction of improving and extending our higher education.

Yet Mr. Fisher's Bill marks a great step forward, and it has received, we are glad to know, a general welcome. It assumes the administrative structure erected by the Act of 1902, and the educational work of the country will continue to be entrusted to the authorities on whom it was devolved by that Act.

The general framework of the Bill and the specific proposals of the Government were clearly explained in Mr. Fisher's speech, from which the following summary has been made:—

The Government desires:—First, to improve the administrative organisation of education.

Secondly, to secure for every boy and girl in this country an elementary school-life, up to the age of fourteen years, which shall be unimpeded by the competing claims of industry.

Thirdly, to establish part-time, day continuation schools, which every young person in the country shall be compelled to attend unless he or she is undergoing some suitable form of alternative instruction.

Fourthly, the development of the higher forms of elementary education and the improvement of the physical condition of the children and young persons under instruction.

Fifthly, to consolidate the elementary-school grants; and

Sixthly, to make an effective survey of the whole educational provision of the country and to bring private educational institutions into closer and more convenient relation to the national system.

A duty is imposed upon the councils of every county and county borough to provide for the progressive development and comprehensive organisation of education in their respective areas and to submit schemes to the Board, and in order that this function may adequately be discharged it is proposed to remove the twopenny limit of the amount to be raised for higher forms of education which was imposed by the Act of 1902. The council of a county or county borough will, in other words, plan out an educational policy. Before submitting its scheme to the Board the council will be required to consult the authorities having power in the county under Part 3 of the Act of 1902 with reference to the mode in which and the extent to which any such authority will co-operate with the county, and the Board will be informed as to the co-operation to be expected from any such authority.

There are some educational problems which can be most conveniently considered in relation to an area larger than a county or county borough, and by bodies representing a wider constituency. The supply of elementary teachers, for instance, could be best dealt with in relation to the large areas. So, probably, could a scheme for scholarships to be held at the secondary schools or the universities. Or, again, the provision and utilisation of secondary schools might be more scientifically planned and with less fear of overlapping in the large area than in the small area. It is, of course, possible under the existing law for authorities to combine for any one or all of such purposes.

The Bill provides distinct statutory authority for the formation of bodies which we may call provincial associations. The Board will be empowered by statute to provide for the establishment of provincial associations after consultation with the authorities concerned, the local education authorities being empowered to delegate administrative and educational functions to these associations, and conversely the associations being empowered to exercise any function so delegated. There will be county and county borough authorities obliged to submit comprehensive schemes of education for their respective areas, and these will be gradually supplemented by provincial associations for those educational purposes which are most conveniently dealt with in relation to areas larger than those of the county and county borough.

The education given in public elementary schools is not to be considered an end in itself, but a stage in the child's education destined to lead to other stages. Local education authorities, under Part 3 of the Local Education Act of 1902, will be required to make adequate provision, either by special classes or by means of central schools, for what may be termed higher elementary education. The Bill provides not only for the introduction of practical instruction at appropriate stages, but also for the preparation of children for further education in schools other than elementary, and for transference at suitable ages to such schools.

The Bill includes a series of proposals designed to improve and to strengthen the existing fabric of elementary education so as to secure to every child in the kingdom a sound physique and a solid groundwork of knowledge before the period when the part-time system begins. The establishment of nursery schools for children under five years is encouraged, and the local education authorities are empowered to raise the age at which normal instruction in the elementary schools begins to six, as soon as there is an adequate supply of nursery schools for the younger children in the area.

The law of school attendance is to be amended so as to abolish all exemptions between the ages of five and fourteen, and further restriction is to be placed upon the employment of children during the elementary-school period. The first of these proposals rests upon the belief that children are introduced to the normal instruction of public elementary schools at too tender an age. At four or five years sleep and play are far more important than letters, and, wherever the home is good, the child should be encouraged to stay with its mother. It is not proposed to compel the provision of nursery schools, but to enable such schools, attendance at which must be voluntary, to be aided from the rates, and in the development of these schools, which will often be open-air schools, a

real improvement in the health of young children may reasonably be looked for.

The second proposal involves as its consequence the abolition of what is known as the half-time system. The system has been condemned by every educationist and every social reformer. It is bad for the physique of the children, it is injurious to the intellectual prospects of the half-timer, and it has been shown not only that the work upon which the children are engaged is not such as to develop the higher forms of industrial activity, but also that when the half-time system is once admitted in the textile industry it spreads to other forms of employment as well.

The third measure for improving elementary-school education is the further regulation of the employment of children during the period of daily elementary-school life. The Government desires a full period of school life, unimpaired by the competing claims of employment, for all children of the working population. At the present moment the effect of our elementary-school education is greatly harmed by the work which is imposed on children out of school hours. They are liable to be employed for three hours before the school opens and for some hours after the school closes, and the general opinion of inspectors is that of all reforms affecting elementary education there is none more vital than the enforcement of strict limitation of the employment of children in their school-going days. The Bill proposes that no child under twelve shall be employed for profit, and here the Bill has been anticipated by by-laws passed in some large municipalities. No child under fourteen shall be employed on any day on which he is required to attend school before the close of school hours or after 8 p.m. on that day, or on other days before 8 a.m. or after 8 p.m. The Bill provides that the local education authorities, if satisfied on the report of the school medical officer or otherwise that the child is being employed in such a way as to be prejudicial to health or education, may forbid or regulate that employment. If the local education authority should decide that it would be wise to continue the elementary education in the elementary schools either of the boys or the girls in their area or of boys or girls following particular occupations in that area up to the age of fifteen they shall be empowered to do so.

The most novel provision in the Bill is that, with certain exceptions, every young person no longer under any obligation to attend a public elementary school shall attend such continuation school as the local education authority of the area in which he resides may require for a period of 320 hours in the year, or the equivalent of eight hours a week for forty weeks. The main exceptions are the following:—Attendance at schools will not be required in the case of a young person who has received to the satisfaction of the Board suitable full-time instruction up to the age of sixteen, or has passed the matriculation examination of a university of the United Kingdom or an examination recognised as an equivalent to that, or is shown to be unsuitable or deficient for part-time instruction. In other words, every young person who has not received a full-time education up to the age of sixteen shall receive a part-time education up to the age of eighteen, either in schools provided by the local education authority or in schools under their direction, such as the schools established by manufacturers in their works. The Bill provides that part-time instruction shall be given by day; it must be taken out of the employers' time, and provision is made to ensure that the young person who is required to attend continuation classes shall not be worked unduly long hours during the days on which the classes are held, and that he or she shall be given a reasonable interval for food, rest, and washing between work and school. The classes are not to be held on Sunday or any holiday or half-holiday which a young person is accustomed to enjoy. The proposal comes to this, that any young person who has to undergo full time for instruction will be liberated from industrial toil for three half-days a week during forty weeks—two half-days to be spent in school, while one will be a half-holiday.

The Bill rightly attaches great importance to physical education. Physical training is already an element, perhaps not a sufficient element, in our elementary-school curriculum, and grants have recently been sanctioned for organisers of physical training in public elementary schools. The present Bill gives physical training a place in continuation schools. Every boy and girl in those schools will receive physical training. It goes even further. It empowers the local education authority to establish nursery schools for young children, to maintain playing-fields, school baths, or school game centres, and equipment for physical training, and it extends the powers and duties with regard to medical inspection now possessed by the local education authorities in the case of elementary schools and secondary schools provided by them, and continuation schools under their control.

In commending the Bill to the consideration of the House, Mr. Fisher said:—"We have reached a point in our history when we must take long views. We are a comparatively small country, and we have incurred the hostility of a nation with a larger population, with a greater extent of concentrated territory, and with a more powerful organisation of its resources. We cannot flatter ourselves with the comfortable opinion —I wish we could—that after this war the fierce rivalry of Germany will disappear and hostile feeling altogether die down, and this in itself constitutes one reason for giving the youth of our country the best preparation which ingenuity can suggest. There is another reason. We are extending the franchise. We are making a greater demand than ever before on the civic spirit of the ordinary man and woman at a time when the problems of national life and of world policy, as to which this House will be called on to decide, have become exceedingly complex and difficult. How can we expect an intelligent response to the demands which the community proposes to make on the constructive judgment of its men and women unless we are prepared to make some further sacrifices in order to form and fashion the mind of the young?

"We assume that education is one of the good things of life, which should be more widely shared than has hitherto been the case amongst the children and young persons of the country. We assume that education should be the education of the whole man, spiritually, intellectually, and physically; and it is not beyond the resources of civilisation to devise a scheme of education, possessing certain common qualities, but admitting at the same time large variation, from which the whole population of the country, male and female, may derive benefit. We assume that the principles upon which well-to-do parents proceed in the education of their families are valid *mutatis mutandis* for the families of the poor, and that the State has need to secure for its juvenile population conditions under which mind, body, and character may be harmoniously developed. We feel also that, in existing circumstances, the life of the rising generation can only be protected against the injurious effects of industrial pressure by a further measure of State compulsion. But we argue that the compulsion proposed in this Bill will be no sterilising restriction of wholesome liberty, but the essential condition of a large and more enlightened freedom. It will tend to stimulate the civic spirit, promote general culture and technical knowledge, and diffuse a steadier judgment and a better-informed opinion through the whole body of the community."

THE REGENERATION OF THE BRITISH SCIENTIFIC INSTRUMENT TRADE AFTER THE WAR.

MUCH attention is being paid at present to the capture of Germany's foreign trade after the war, and the same arguments that apply in other spheres hold good for the scientific instrument trade as well. The Germans, thanks to their efficient organisation and methods of education, had been able, at the time the war broke out, to attain a supreme position in this branch of their export trade. To quote one instance from statistics: Germany exported to Russia alone, in 1913, mathematical, physical, and chemical instruments to the value of nearly two millions sterling, and chemical and pharmaceutical products to almost the same amount. While corresponding figures are not available in a complete form for similar British products, there is every reason to believe that they represent only a small fraction of these amounts.

The following notes, based on conversations the writer had with the directors of two of the leading German manufacturers of physical and chemical apparatus, will explain the reason for Germany's success and point out the direction in which British manufacturers should proceed after the war.

In nearly every case the German youth desiring to adopt scientific instrument making as a trade has to serve a long apprenticeship in the particular branch to which he intends to devote his energies. This training is supplemented by courses in elementary science (including in many cases mathematics) held in the continuation schools (*Gewerbeschulen*), of which there are one or more in any town of importance. Thus, in addition to knowing how to construct an instrument, the German craftsman generally knows exactly what function that instrument is intended to perform—he crystallises his scientific notions into his daily work. He also realises the value of precision. It is highly important, therefore, that English instrument makers should be afforded more ample facilities for obtaining this scientific training at the same time as their workshop experience, in order to avoid the mere mechanical repetition which their practical experience calls for.

In Germany there is closer *rapprochement* between instrument-making firms and college and university teachers, with the result that new forms of apparatus are being continually evolved for proving a given law or explaining a scientific phenomenon. A perusal of the catalogues of Kohl, Enencke, and other firms will show the diversity of apparatus that were current articles with these houses.

It is to be hoped that after the war some publishing house will consider the advisability of establishing a periodical devoted to the theoretical and practical side of instrument making. Germany possesses more than one such organ, viz. the *Zeitschrift für Instrumentenkunde* (with its supplement, *Deutsche Mechaniker-Zeitung*, devoted to the practical side of instrument making) and *Der Mechaniker*. The former journal is at the same time one of the many organs of the Physikalisch-Technische Reichsanstalt (the German National Physical Laboratory). Whenever a purely physical instrument is designed in that institution, the experimental data leading up to its design, as well as the mechanical details, are published in the *Zeitschrift für Instrumentenkunde*, the editorial staff of which includes one or more members of the Reichsanstalt staff. The value of such a journal to instrument makers, especially when their own staff includes men with a thorough scientific training, is incalculable.

Again, in order to make scientific products known abroad, the Germans resorted to an extensive system of propaganda, by means of elaborate descriptive catalogues printed in the language of the country with which they wished to deal. Many of these catalogues embrace almost every known instrument for teaching and other purposes.

British manufacturers, my German informants told me, are quite as capable as the Germans of constructing instruments of precision equal in every respect to the German products. There is no reason, therefore, why they should not secure a large share of the business that was done by Germany in pre-war days, provided they (1) take steps to construct a more comprehensive range of apparatus; (2) keep pace with modern scientific requirements; (3) keep in closer touch with British men of science; (4) give more attention to the publication of catalogues in foreign languages; and (5) establish a journal embodying the peculiar features of the *Zeitschrift für Instrumentenkunde*.

E. S. HODGSON.

DR. FÉLIX LE DANTEC.

IT is with regret that we have to record the death of a well-known French biologist, Dr. Félix Le Dantec, at the age of forty-eight years. For many years a sufferer, he hastened his end by generous work in the war hospitals, though indeed the flame of his life always burned too quickly to last long.

Of Breton extraction and precocious talents, Dr. Le Dantec studied in Paris under Pasteur, Metchnikoff, and other great masters. His doctorate thesis dealt with intra-cellular digestion in the Protozoa. Although he returned at times to similar investigations, *e.g.* on Sporozoa and Bacteria, he was led by temperament and by circumstances to a kind of life which the pure investigator often fails to understand. On the one hand, Le Dantec was, as he said himself, an intellectual adventurer; he could not desist from the pursuit of the elusive—What is life? What is individuality? What is personality? What is sex? What is evolution? What is knowledge? His last book, which was published this year, is entitled "Savoir." On the other, he had the vocation of a teacher, and fulfilled it with an extraordinary industry and enthusiasm, unsparing of his own vital resources. We refer not so much to his work as lecturer in Lyons and *préparateur*

in Paris, but to his extraordinary writing of books, in which we see an heroic effort to win a way to clearness for himself and others. Thus we have "La matière vivante," "La Théorie nouvelle de la vie," "Evolution individuelle et Hérédité," "Traité de Biologie," "Le Déterminisme biologique," "Les Influences ancestrales," "La Lutte universelle," and at least ten more!

Dr. Le Dantec was a biologist of the mechanistic school; he held to a hard-and-fast determinism; he was a devoted disciple of Lamarck; he made passionate endeavours after scientific clarity as opposed to what he regarded as superstitious sentimentalism, metaphysical verbiage, and intellectual hypocrisy. While many of his radical ideas have been criticised as too abstract and simplicist, not gripping the actual facts of life, many others were certainly luminous and useful, such as that of the organism continually trafficking with its environment, sustaining itself by functioning, "l'édification de la vie par la vie." Of the man himself there is no doubt: his whole life spoke of courage, sincerity, a passion for veracity, a willingness to follow what he thought was truth wheresoever it led him.

NOTES.

ON August 9 to a large magnetic storm was recorded at Kew Observatory. It began with a "sudden commencement" at about 4.14 a.m. on August 9. The "sudden commencement" was unusually large, especially in D (declination). In H (horizontal force) it was not visibly oscillatory, consisting of a rise of about 110 γ ($1\gamma = 1 \times 10^{-5}$ C.G.S. unit). In D it was distinctly oscillatory, an easterly movement of about 4′ being followed by a westerly movement of about 17′. The extreme westerly position of the needle was reached about 4.50 a.m. on August 9, when the needle pointed 34′ more to the west than it did when the storm began. The D trace was highly oscillatory at times, especially between 9.30 and 10.30 a.m. on August 9. Conditions became much quieter after 11 a.m., and continued so until 9.20 p.m. on August 9, when there was a recrudescence of the storm. The extreme easterly position was reached about 0.24 a.m., on August 10. The storm had pretty well subsided by 4 a.m. The total range of D during it was approximately 55′. The disturbance in H, generally speaking, waxed and waned in intensity with that in D, but did not show so much abatement between 11 a.m. and 9.20 p.m. on August 9. The recrudescence after 9.20 p.m. on August 9 was, however, conspicuous. The lowest and highest values of H were both recorded on August 9, the former about 9.30 a.m., the latter about 9.30 p.m.; the total range was about 370 γ. During the greater part of the time the vertical force trace was not much disturbed. The value of the element was slightly depressed during the morning hours of August 9, and there was a considerably larger depression between 9.30 p.m. on August 9 and 2 a.m. on August 10. The range of the element during the course of the disturbance was about 250 γ. The disturbance was of the kind usually accompanied by aurora.

IT was announced in NATURE of August 2 that the Museums Association proposed to hold a conference in October next. The announcement was based upon a circular, dated July 24, asking persons who intended to be present to communicate with Mr. E. E. Lowe (Museum and Art Gallery, Leicester), who is hon. secretary of the association. A circular dated August 2, signed by the members of the Executive Committee, has now reached us, and we learn from it that the proposed conference will not be held, as a sufficient number of promises to attend has not been received.

THE High Commissioner for New Zealand has been informed by cable that reports of the damage done by the recent earthquake in the southern part of North Island were much exaggerated, and that the earthquake was in no way destructive.

MR. CHARLES T. DRUERY, who died on August 8, was a naturalist as well as a horticulturist of eminence. At a time when not many horticulturists were inclined to see beyond the horizon of their gardens, Mr. Druery did much to encourage the wider outlook which has now become more general. His passion for the study of ferns, and in particular for the abnormal and monstrous forms, led him to see that the science of genetics must be called in to help to explain the ways of cultivated as well as of wild plants. Of alert mind, he recognised at an early date the importance of Mendel's work, and it was his pen that wrote the first English translation of Mendel's famous memoir. In recognition of his services to horticulture his name was enrolled among those of the sixty original recipients of the Victoria Medal of Horticulture. A gifted linguist, Mr. Druery wrote on subjects other than horticulture. Quite recently he published a volume of verse—of a humour akin in type to that practised by early Victorians—and his many friends were compelled to admire, not only the versatility, but also the youthfulness of mind of a man who, though of advanced age, proved himself younger than most of those of a later generation.

DR. A. CALMETTE, director of the Institut Pasteur, Lille, and Dr. L. Martin, director of the Hôpital Pasteur, have been appointed to subdirectorships at the Institut Pasteur, Paris.

THE G. C. Greenwell silver medal of the North of England Institute of Mining and Mechanical Engineers has been awarded to Prof. W. G. Fearnsides for his paper on "Some Effects of Earth-movement on the Coal-Measures of the Sheffield District (South Yorkshire), and the neighbouring parts of West Yorkshire, Derbyshire, and Nottinghamshire."

ACCORDING to the *Journal of Industrial and Engineering Chemistry*, the Seaman gold medal, which is each year awarded by the American Museum of Safety for the promotion of hygiene and the mitigation of occupational disease, has been conferred upon the Julius King Optical Company of New York, for their appliances against the dangers of ultra-violet and infra-red light.

MAJOR J. C. WOODS has been awarded the Gaskell prize of the Medico-Psychological Association of Great Britain and Ireland, consisting of fifty guineas and a gold medal, and Dr. M. Krohn a replica of the medal in silver and the sum of fifteen guineas.

THE National Academy of Sciences of the United States has received from Miss M. H. Elliot the sum of 8000 dollars to establish a fund in memory of her late father, Daniel Giraud Elliot, and has accepted the trust. A medal, to be known as the Daniel Giraud Elliot gold medal, and an honorarium will be awarded annually for a paper, essay, or other work in some branch of zoology or palæontology published during the year. The award is not restricted to naturalists resident in the United States. Drs. H. F. Osborn,

C. D. Walcott, and F. A. Lucas have been appointed judges for the bestowal of the medal and honorarium. It is expected that it will be possible for the first award to be made in April, 1918.

THE mycological collection of the late Dr. J. W. Ellis has been acquired by purchase by the herbarium at Kew. It comprises nearly 1600 dried specimens, is especially rich in micro-fungi, and includes a series of mounted specimens of those of economic importance. There are also 330 microscopic slides.

AN Aerial Postal Service between Italy, Sicily, and Sardinia has already been established, as we read in the *Journal of the Society of Arts,* August 3. The first post was inaugurated on June 24 between Naples and Palermo, and three days later the next service, from Civita Vecchia on the mainland to Terranuova-Pausania (Sardinia). In the first trip from Naples to Palermo, a seaplane was used, carrying a heavy mail, flying at a height of 1500 to 2000 metres at 140 kilometres (say ninety miles) an hour, reaching Palermo in less than two hours and a half. The service from Civita Vecchia to Sardinia was opened on June 27 by two seaplanes, each carrying 100 kilogrammes of mail in watertight bags. The passage was made in an hour and forty minutes, leaving Civita Vecchia at 6.20 a.m. and reaching Terranuova about 8 a.m., and the return journey was made in about the same time.

AN appeal for the loan of prismatic compasses for use in the Army has been issued by the Countess Roberts. Any good prismatic compass, such as is used for map-making and surveying, would be acceptable. The instruments would be engraved and registered under the lenders' names to facilitate their return, when possible, after the war. They should be sent to the Manager of Lady Roberts's Field Glass Fund, 64 Victoria Street, S.W.1.

THE Cavendish lecture of the West London Medico-Chirurgical Society was delivered on June 22. The lecturer, Capt. Andrew Macphail, Canadian Army Medical Corps, who is professor of the history of medicine at McGill University, Montreal, took as his subject "A Day's Work." In a word-picture of considerable power he described the medical organisation of that part of the Army concerned with the attack on, and capture of, the Vimy Ridge. "The Medical Service, above all other services, has done its perfect work. It has yielded an army without sickness. I have never seen a case of typhoid, and the few infectious cases are of the nature of children's diseases. Except for a few days on the Somme, I have not seen more flies than one would see on a well-kept farm. Purified water is put into the men's bottles. To drink from an unauthorised source is a crime. Wells are examined even whilst they are yet under fire, and food is scrutinised before every meal. Men are bathed as methodically as they are fed, and by fire and steam the advances of the humble, but friendly, louse are discouraged. One acquires a certain pity for this most dependent and helpless of all creatures —his means of livelihood are so restricted and he is so unbeloved." He finally concluded with some inspiring sentences on the outlook, the lessons of the past, and the messages of war.

THE *Eugenics Review* for July (vol. ix., No. 2) contains an abstract of an address by Judge Henry Neil on the Mothers' Pension System, of which he is the founder. The State legislature of Illinois eleven years ago inaugurated the system, and at the present time thirty other States have adopted it. Mothers' pensions are maintenance grants made in respect of children under fourteen to a parent who is a "proper guardian"—that is to say, of established good character, but too poor to feed, clothe, and "home" her children adequately. The money is provided by general taxation, and the pensioned mother is put on the county pay-roll and receives her cheque every month. If she prove herself unable to handle the money properly her pension may be revoked, but very few cases of any abuse of this kind occur, and practically about three-fourths of the destitute children in the thirty States in which this pension system has been adopted are now looked after at home. Supervisors, appointed by each State, see that the children are properly cared for, and an immense saving in public money has been effected, the cost per child being about one-third that incurred by institutional care.

DRS. BROWNING, Gulbransen, and Thornton give a further contribution on the antiseptic properties of flavine and brilliant green, with special reference to their suitability for wound treatment, in the *British Medical Journal* for July 21, p. 70. Flavine compounds and brilliant green are antiseptics which exert a slowly progressive bactericidal action. Concentrations of these substances, which at first inhibit, and finally kill, bacteria, are without harmful effect on the tissues locally or generally. Flavine compounds are enhanced in their bactericidal potency by the presence of serum, while brilliant green, in common with most other antiseptics, is reduced in its activity by serum. Brilliant green satisfies requirements for application by repeated irrigation in aqueous solution (1 : 2000), while with flavine, since it is most potent in the presence of serum, the indication is to arrange the wound dressing so that it may act in a serum medium. Operative measures are an essential preliminary to the effective use of therapeutic antiseptics in wounds, since the antiseptic can act only when brought into intimate contact with the infected tissues.

WHEN Mr. and Mrs. Routledge finished their investigations on Easter Island in 1915, they touched at Pitcairn Island, and there engaged two brothers, direct descendants of the *Bounty* mutineers, Charles Young, aged twenty-eight, and Edwin Young, aged twenty-five, to serve as hands on their yacht *Mana*. On their arrival in England these young men were sent to the Royal College of Surgeons to undergo examination by Prof. A. Keith and Dr. W. Colin Mackenzie. This is the first opportunity enjoyed by European anthropologists of examining members of this interesting community. From their report, published in the August issue of *Man,* it appears from examination of their genealogy that their ancestral composition should be 13/32 parts British and 19/32 parts Tahitian. Prof. Keith sums up the result of the examination as follows:—"I regard the two Pitcairn Islanders as decidedly more Tahitian than European in their physical characteristics. In facial features Charles is European, Edwin is not, yet in actual shape of the head the case is reversed—Charles has the typical Tahitian head, Edwin rather the European; in texture of hair they are Tahitian rather than European. In size of brain they are typical of neither British nor Tahitian, but incline rather to the second than to the first. But there can be no question of physical degeneration; they are both splendidly developed men." They belong to the sixth generation of the descendants of the mutineers—six generations in 127 years.

THE *Museum Journal* published by the University of Pennsylvania (vol. vii., No. 4, December, 1916) contains an account of the University expedition to the Amazon in 1913, under the superintendence of Dr. F. H. Church and Mr. W. C. Farabee. An interesting account is

given of the Macusi and Wapisiana tribes, representatives of the Carib and Arawak linguistic families. The Macusis practise the custom of the couvade, the father, after a child is born, taking to his bed for a month, and eating none but the most delicate foods, the mother meanwhile taking care of him and of the baby. The Wapisiana also practise the couvade, but the period of careful eating for the father extends among them to a year after he leaves his bed. Their marriage system is interesting, because they are required to marry blood relations. A man must marry his cousin from another village and take her home to his own village. He may, and often does, marry two sisters, and he can take a wife outside his family only in case there are no cousins available. They will not eat game shot by a gun or arrow, and their diet is confined to fish and fruit. The rubber traffic and the cruelty of foreigners have been fatal to the natives of this region. There are but two survivors, two sisters, of the once-important Zapará tribe. It is well that a scientific examination of them has been made before they become extinct.

MR. H. U. HALL publishes in the *Museum Journal* of the University of Pennsylvania (vol. viii., No. 1, March, 1917) a well-illustrated paper on a collection of gods of the Yoruba tribe of the hinterland of Lagos, West Southern Nigeria. Before a burial a masked dancer wearing the shroud of the dead man dances before his relations, condoles with them, and discusses matters in which they and the dead man were interested. Offerings made to his mask are supposed to be passed on to the deceased in deathland. To prove that the dead man has gone to heaven, a person representing him is hidden in a room close by, and answers questions regarding the fate of the deceased. This person, known as Egun, seems to have been originally regarded merely as an incarnation of the dead man, but he has now developed into a kind of bogy, whose function it is to carry away persons who have become a nuisance to their neighbours—scolds, busybodies, scandalmongers. In his public character his very touch is fatal, and to threaten an Egun with personal violence, or for a woman to speak disrespectfully of him, is an offence punishable with death.

IN the August number of the *Fortnightly Review* Sir Thomas Holdich discusses the suggestion of a federation of the southern Slavs into one great Jugo-Slav nationality. The federation would include Slovenes, Croats, and Serbians, and extend from the Save basin to the southern borders of Serbia, covering an area of at least 75,000 square miles, and containing a population of more than twelve millions. It would include Serbia, Bosnia and Herzegovina, Croatia, southern Styria, southern Carinthia, possibly part of Carniola, and Slavonia and Syrmia. One of the great difficulties would be the question of Dalmatia and Istria. Despite the nationality of their inhabitants, these two Adriatic lands are geographically more related to Italy than to the Balkan lands. Dalmatia is separated from Bosnia by the natural barrier of the Dinaric Alps, and would scarcely serve as the chief sea outlet for the Jugo-Slav State. That outlet, Sir Thomas Holdich thinks, should be at Salonika. It is interesting to note that the author suggests the river Drave from near its source to the Danube as part of the northern boundary, but he proposes that a new capital should be chosen for Serbia at Nish, less exposed to aggression than Belgrade.

THE first part of a "Bibliography of Fishes," the work of Dr. Bashford Dean and Dr. C. R. Eastman, has just been published by the American Museum of Natural History. It consists of the first instalment (A to K) of a list of titles of papers, arranged under authors' names, and is a large octavo volume of 718 pages. When completed it will include some 40,000 titles. The authors regard the time as opportune for the preparation of a compendious list of papers dealing with fishes, since the group is fairly well known, and there is now increasing difficulty in dealing with the literature in the absence of any special bibliography. Further parts will complete the list of titles by the inclusion of anonymous publications and pre-Linnæan works. Then will follow a summary of general bibliographies in which papers dealing with fishes are listed; an account of works describing voyages and expeditions in which fishes are observed and described; and a list of periodicals relating to fish culture. A subject-index is in course of preparation, and in this part reference will be made to the index of authors' titles. These titles will not be repeated, the papers being identified by the author's name, the year of publication, and a number indicating order of publication should more than one paper have been published by the author during the same year. Fossil as well as recent forms are included. In general the bibliography deals with the morphology, development, physiology, pathology, distribution, and habits of fishes, but works on angling are not as yet considered.

THE fourth part of the Annals of the Durban Museum (vol. i., pp. 291–431) is a list of the sea-fishes recorded from Natal, and is the work of Dr. J. D. F. Gilchrist and Mr. W. W. Thompson. It is purely a systematic list, containing no reference to the local occurrence, or habits, or uses of the species recorded, and its size is due to the inclusion, under each specific name, of the authors who have already described the species and of the publications in which these descriptions have appeared.

MR. HENRY J. HOWARD records the first-known British gathering of the Mycetozoon, *Physarum carneum* (Journ. Roy. Microscop. Soc., 1917, part iii., June, p. 265). It was first found on dead wood on Cheyenne Mountain, Colorado Springs, by Dr. Sturgis in 1908. Previous to Mr. Howard's gathering, only one other European specimen was known, from the grounds of Collegia de Campolide, Lisbon.

MR. H. M. STEVEN, Carnegie research scholar in the University of Edinburgh, has published, in the Transactions of the Royal Scottish Arboricultural Society (vol. xxxi., July, 1917, pp. 131–55), an important paper on the relation of the Chermes group of insects to British forestry. These insects, which were not clearly described until recently, are remarkable for their obscure and complicated life-history. They attack conifers, and do much damage to ordinary plantations of various pines and of common larch, spruce, and silver fir. Mr. Steven gives an elaborate account, with seven figures, of the species known to exist in Britain, which are now assigned to four genera, Chermes (in a restricted sense), Cnaphalodes, Pineus, and Dreyfusia, each with two species. He admits that once a plantation is formed there is no practical method of dealing with these pests; but, as healthy, vigorous trees are scarcely attacked, much may be done in the way of prevention by choice of species clearly suitable to the conditions of the area. Certain exotic species, which are at present relatively immune, may be often chosen, and amongst these are valuable trees, like Japanese larch, Sitka spruce, and Corsican pine. Steven's distinct contribution to preventive measures is based on observations that Chermes insects were often widespread in tree nurseries, and did most serious damage immediately after a plantation had been formed. Fumigation with hydrocyanic acid gas generated from potassium cyanide effectually kills insects on nursery

stock, and young trees thus treated when planted out have a good chance of establishing themselves in their new environment. Subsequent infection, though possible, does little harm.

THE current number of the Science Reports of the Tôhoku Imperial University (second series, Geology, vol. iv., No. 2) contains a useful contribution to our knowledge of the distribution of the genus Gigantopteris by Prof. Yabe, with descriptions of three Asiatic species by K. Koiwai. The genus Gigantopteris was founded by Schenk for some fernlike fronds from the Lui coalfield in south-central China, for which he originally proposed the name Megalopteris in ignorance of its previous use by Dawson. Dr. D. White in 1912 (Proc. U.S. Nat. Mus., vol. xl., p. 493, 1912) recorded the occurrence of a new species of Gigantopteris in Permian beds in Texas and Oklahoma, and brought forward evidence in favour of including Schenk's genus in the Pteridosperms. Prof. Yabe now records the occurrence of Gigantopteris in some new Asiatic localities, and discusses the geological and geographical range of the genus; he recognises four species, White's *G. americana* of Permian age and three from Permian and Triassic strata in Manchuria, Corea, and southern China. The chief interest of the paper lies in the additional data with regard to the distribution of Gigantopteris in space and time. Prof. Yabe also contributes a paper on "Problems concerning the Geotectonics of the Japanese Islands," with critical reviews of various opinions expressed by previous authors. The same publication includes a paper by I. Hayasaka on "A New Hydrozoan Fossil from the Torinosu Limestone (Lower Cretaceous) of Japan," for which he founds the genus Circoporella, thus directing attention to its close alliance with Circopora, a genus instituted by Waagen and Wentzel for a type from the Productus Limestone in the Salt range in India. The figures given by Hayasaka resemble sections of certain calcareous Algæ, but the resemblance may be superficial.

IN the Transactions of the Geological Society of South Africa, vol. xix. (1917), p. 33, Prof. Schwarz records the discovery of diamonds in the Molteno Beds of Molteno, Cape Province, associated with other detrital minerals, such as might arise from the decay of a crystalline schist. He quotes Mr. E. J. Dunn as agreeing with him that important evidence is thus furnished that the South African diamonds are older than the igneous pipes which have brought them in many places to the surface. In the same volume (p. 54) Mr. P. A. Wagner describes from Jagersfontein nodules of ultrabasic character, peridotite and garnet-diopside-eclogite, which contain graphite, and regards them as fragments of deep-seated equivalents of the diamond-bearing kimberlite in which they occur. Mr. Wagner, in the discussion on Prof. Schwarz's paper (Proc. Geol. Soc. South Africa, 1916, p. xli), evidently recognises the divergence of view, and asks for fuller evidence that the detrital splinters are true diamonds. The much-desired section reaching down to an eclogite mass, either traversed by, or merging into, a pipe of kimberlite, is unfortunately not yet revealed in South Africa.

THE cider-apple crop would appear to offer possibilities of a substantial and wholesome addition to our food supplies in these days of stringency. According to recent estimates the average English crop is not less than 200,000 to 250,000 tons, whilst that of France approaches $2\frac{1}{2}$ million tons. Much of the surplus not absorbed by the cider industry has in the past been wasted owing to the difficulty of providing any satisfactory alternative outlet. In some seasons the jam manufacturer has taken considerable quantities of the sharp or acid varieties, but the sweet and bitter-sweet varieties which form the bulk of the crop have hitherto proved quite intractable, the tissues remaining tough and leathery even after prolonged boiling. This defect has been commonly ascribed to the relatively high tannin content of the cider apple, in which case it is difficult to understand the satisfactory results obtained at the jam factory with some of the sharp varieties. From experiments carried out by Prof. B. T. P. Barker at the University of Bristol Horticultural Research Station it seems more probable that the difficulty is associated with the pectins of the fruit. The Bristol experiments, of which a brief account is given in the July issue of the *Journal of the Board of Agriculture*, have shown that the yield of soluble pectins from apples is substantially increased by digestion with weak acid, and that by suitable application of this treatment, using a dilute solution of tartaric acid, the most resistant apples can be reduced to pulp and converted into a palatable jam. Citric acid serves equally well, or, if available, acid fruit or fruit juices can be used with advantage.

IN the current Bulletin (vol. vii., No. 2, for June, 1917) of the Seismological Society of America, there are two studies of recent Californian earthquakes. The Tejon Pass earthquake of October 22, 1916, is described by Prof. J. C. Branner, and the Santa Barbara Channel earthquakes of April 12 and 20, 1917, by Mr. A. C. Mattei. The epicentre of the earlier and more important earthquake (of intensity 7) seems to have been near the summit of the Tejon Pass, which is about sixty miles north-west of Los Angeles; and Prof. Branner supposes that the earthquake was due to a movement along the fault which traverses the pass in the E.S.E. direction. It has been suggested, though on insufficient evidence, that this fault is a continuation of the San Andreas fault along which the San Francisco earthquake of 1906 originated. All three earthquakes here described visited thinly populated districts, and the maps of isoseismal lines which accompany the papers can only be regarded as approximate. In the same number Mr. Otto Klotz gives a brief notice of the late Prince Galitzin, and also a revised determination of the velocity of the L or surface waves. In adopting the value of 230 km. per minute, he considers that more extended data will confine any amendment of this value within one per cent.

THE report on the work of the Imperial Institute just presented to the Executive Council states that, apart from confidential reports to the Admiralty, the Ministry of Munitions, the War Trade Department, and other Government departments, reports were completed on the composition, value, and commercial prospects of raw materials from eighteen countries in the Empire overseas, while the inquiries received and answered related to as many as thirty British countries. A possible new raw material for paper manufacture is indicated by the increasing use of wattle bark by British tanners. Large quantities of the spent bark are likely to be available in the United Kingdom, and investigations conducted at the Imperial Institute show that, though the yield of pulp from the bark is somewhat low, the material is promising for the production of brown paper and the cheaper grades of white or cream papers, such as newspapers. Arrangements are being made at a British paper mill for a large-scale trial of the spent bark. A special monograph dealing with the occurrence and utilisation of zinc ores through the world, with special reference to the British Empire, is in preparation. An inquiry has been received from Zanzibar regarding the disposal of clove stems, which before the war were shipped principally to Germany.

The possibility of distilling oil from them has been discussed with a number of essential oil distillers, and as a result it appears probable that a market may be found for the stems for that purpose.

DR. P. P. PODJAPOLSKY has for some years been investigating the occurrence of chlorophyll in various animals ("On Chlorophyll in Animals and on the Fate of Chlorophyll in the Animal Organism," Moscow, 1916). He finds that a green pigment, giving an absorption band between the lines B and C of the spectrum, can be extracted from the wings and elytra of a number of Orthoptera, and from the skin of some frogs (*Rana esculenta, Hyla arborea*). As the band described coincides exactly with that shown by an extract of a green leaf, such as that of Robinia, he concludes that chlorophyll itself is present in these animals. He suggests that chlorophyll in animals may be produced *de novo* by the animal, or it may be derived from ingested plant material escaping digestion wholly or in part, or it may be the result of symbiosis. He states also that the chlorophyll band between B and C may be observed in spring in the bile of grass-fed herbiverous animals, such as cows and sheep. Dr. Podjapolsky has been able to recognise not only chlorophyll but also bile pigment in a pyridine extract of the contents of the stomach of the mammoth discovered in a glacier at Beriosov, and now preserved at Petrograd. From the position of the animal it would seem to have slipped backwards on the ice, and its violent efforts to recover itself probably caused a regurgitation of bile into the stomach. It is surprising that the author makes no attempt to explain his use of the term chlorophyll, and gives no reference to the work of Willstätter, who has, of course, clearly shown that crude chlorophyll contains four distinct pigments, two green and two yellow.

THE well-known "Index of Spectra" compiled by Dr. Marshall Watts (London: W. Wesley and Son) has been further extended by the recent publication of Appendix X. The principal tables refer to the arc and spark spectra of gadolinium, gallium, germanium, gold, holmium, indium, and copper, and to the spectra of hydrogen and helium. Most of these have been brought well up to date, but the extension of the band spectrum of helium by Fowler, and the important observations of the "proto-helium" lines by Paschen, appear to have been overlooked. In the case of elements having very complex spectra, the tables have been shortened by the exclusion of the fainter lines, and it will still be necessary to refer to original sources when full information is required. Formulæ are given for certain spectral series, and in this connection it may be noted that Dr. Watts continues to use the term "oscillation-frequency" when "wave-number" is meant. References to recent literature are very numerous, and the new appendix will be a valuable aid to those who are engaged in spectroscopic investigations.

MESSRS. MASSON ET CIE (Paris) have in preparation for appearance in their series "Collection Horizon, Précis de Médecine et de Chirurgie de Guerre":—"Plaies de la Plèvre et du Poumon," Prof. R. Grégoire; "Troubles mentaux de guerre," Prof. J. Lépine; "Blessures de la Moelle et de la Queue de cheval," Drs. G. Roussy and J. Lhermitte; "Electrodiagnostic de guerre: Clinique. Conseil de réforme. Technique et interprétation," Prof. A. Zimmern; and new editions of "Hystérie-Pithiatisme et Troubles nerveux d'ordre réflexe en Neurologie de guerre," J. Babinski and J. Froment; "Formes cliniques des Lésions des Nerfs," Mme. Athanassio-Benisty; "Les Blessures de l'abdomen," J. Abadie.

OUR ASTRONOMICAL COLUMN.

THE AUGUST METEORS OF 1917.—Mr. W. F. Denning writes that at Bristol the weather conditions were very favourable for observation on Saturday, August 11. The number of meteors visible to one observer in 4h. 40m. watching, 9h. 10m. and 14h. 10m. Greenwich Mean Time, was 219, of which 195 were Perseids. Mr. Denning was assisted in recording the shower by a friend, Mr. P. O. Wright, who, alternately with the former, counted the meteors as they appeared. A few rather brilliant objects were seen, four being estimated to equal Venus and nine to equal Jupiter, while there were many first magnitudes. The radiant was situated in the usual position at $45°+58°$, and the point was well defined. The maximum of the shower occurred between 13h. and 14h. G.M.T., when more than one meteor per minute appeared, though the moon, a little past the last quarter, was shining in the heavens. On the whole the shower was decidedly brighter than the average, both in point of numbers and in the brilliancy of the meteors. It was probably the best Perseid display witnessed at Bristol since 1898. Of the minor showers of the epoch there was comparatively little evidence, but there was a prominent shower of Cygnids from about $292°+50°$. The meteors were bright, and at the ends of their flights burst with flashes of bluish-white light. This shower was also well observed contemporary with the Perseids in August, 1893.

NEW ELEMENTS OF MARS.—An investigation of the discordance between the positions of Mars deduced from observations and those computed from Newcomb's tables has been made by Dr. F. E. Ross, and published by the Nautical Almanac Office, U.S. Naval Observatory (Astron. Papers, vol. ix., part ii.). The following new elements of the orbit of the planet are given:—

Fundamental epoch, 1900 Jan. 0, Greenwich Mean Noon. T, time from this epoch in Julian centuries.

Mean Longitude:—

$l=293° \; 44' \; 51{\cdot}46'' + (53 \text{ rev.} + 222117{\cdot}33'')T + 1{\cdot}1184''T^2.$

Longitude of Perihelion:—

$\pi=334° \; 13' \; 5{\cdot}53'' + 6626{\cdot}73''T + 0{\cdot}4675''T^2 - 0{\cdot}0043''T^3.$

Eccentricity:—

$e=19247{\cdot}168'' + 18{\cdot}9895''T - 0{\cdot}0158''T^2.$

$=0{\cdot}09331290 + 0{\cdot}000092064T - 0{\cdot}000000077T^2.$

Longitude of Node:—

$\theta=48° \; 47' \; 11{\cdot}19'' + 2775{\cdot}57''T - 0{\cdot}005''T^2 - 0{\cdot}0192''T^3.$

Inclination to Ecliptic:—

$i=1° \; 51' \; 1{\cdot}20'' - 2{\cdot}430''T + 0{\cdot}0454''T^2.$

Logarithm of Mean Distance:—

$\log a = 0{\cdot}182897034.$

Theory and observation, which were discordant to the amount of six seconds of arc in R.A. in 1905 and 1907, are brought into more satisfactory agreement by these elements. Tables for correcting the heliocentric positions are given.

ELEMENTS OF SUN'S ROTATION.—A new determination of the direction of the sun's axis has been made by Th. Epstein (*Astronomische Nachrichten*, 4892). It is based upon observations of fifty-eight spots in various latitudes, made in the years 1903 to 1910. The value obtained for the longitude of the ascending node of the equator is $73° \; 59{\cdot}2'$, and for the inclination of the axis to the ecliptic $82° \; 43{\cdot}7'$. These are in very close agreement with Carrington's values, and there is evidently no sufficient reason to modify the existing tables for physical observations of the sun.

THE BRITISH SYNTHETIC COLOUR INDUSTRY IN WAR TIME.

THE lecture delivered to the Society of Arts by Mr. C. M. Whitaker in December last merits a more than passing notice as illustrating the difficulties in the way of British dye producers during the war period and the manner in which a commendable degree of success has been obtained in coping with the dye shortage. It deserves to be more generally known that even before the war British firms were already opposing a resolute front to German competition. These firms not only issued pattern-cards and circulars comparable in style with those sent out by their foreign rivals, but they also dealt with the difficulty of language by printing these manuals of instruction in the principal European tongues. Even in 1906 these instructions had been furnished by the pioneer firm of Read Holliday and Sons, Ltd., in all these languages, and also in Japanese. Very early in the development of the colour industry this firm had acquired the Schutzenberger and Lalande patent for dyeing indigo by the modern scientific process with hydrosulphite, and even to-day the older dyers sometimes refer to this method of indigo dyeing as the "Holliday" vat.

The lecturer pointed out from his own personal knowledge that the practice of sending out practical dyers to assist the firm's *clientèle* of dye-users in their application of the colouring matters is not exclusively a German procedure. The above-mentioned firm and its successors, British Dyes, Ltd., have afforded their customers this expert assistance for more than thirty years.

At the outbreak of war the British dye industry was in the hands of four or five firms, who together controlled a capital not greatly exceeding half a million sterling, and the problem confronting this group of industrialists was how to replace the former German import of dyes having an annual value of about 1,800,000*l*. Even in peace times such a problem would be incapable of immediate solution, but taking into account the distractions of war, the results obtained in the last two years are distinctly encouraging. The vulnerable point in the British position was not, however, that of lack of capital, but rather the bad habit which had arisen of buying from abroad intermediate products which could with comparatively little expert knowledge be converted into finished dyes. An additional handicap arising from this cause was the shortage of chemists having the necessary works experience. Attention is being concentrated on these two vital points. The two leading firms, British Dyes, Ltd., and Messrs. Levinstein, Ltd., have taken into their employment a large number of college-trained chemists, some of whom are exercising their talent for research on the essential intermediates, while others are acquiring works experience in the supervision of industrial processes and in the handling of men.

It is impossible for those untrained in organic chemistry to have any correct perception of the amount of preliminary work which precedes the production of a coal-tar dye. The complete manufacture of an ordinary synthetic black may involve twenty-one distinct chemical operations. Other modern products require even more processes. The British dye firms certainly deserve full credit for their success in coping with the vitally urgent requirements of the Allied Governments in equipment colours. One British firm alone furnished the military authorities with 145,000 lb. of wool khaki dyes in the fateful month of December, 1915, when Army requirements were increasing to an enormous extent. This supply of wool khaki dyes has been maintained, together with prodigious amounts of cotton and linen khaki colours. The armies of our Italian and Russian Allies have also been largely supplied from British sources. The appearance of the uniforms of soldiers returning on leave is the best testimonial to the fastness of British-made khaki dyes, showing that these colours can withstand the severest war conditions.

In the valuable discussion which followed the lecture the points of interest raised were the question of the multiplicity of names for the same dye and the possibility of simplification in this respect, the German monopoly of bromine, and the relations of the dye-producing industry and teaching institutions.

G. T. MORGAN.

THE ROTATION OF THE MOON.[1]

AN interesting *résumé* of the progress of our knowledge of the moon's rotation, together with a considerable amount of original work, is given in the memoir before us. The author recalls the remarkable control which the earth exerts on the rotation; the line joining the poles of the moon's equator and orbit always passes through the pole of the ecliptic, which lies between them, $1\frac{1}{2}^\circ$ from the first, $5\frac{1}{4}^\circ$ from the second; both poles revolve round the pole of the ecliptic in 18·6 years. The earth's action has also forced the period of rotation to coincide with that of revolution; the existence of this action is still in evidence from the fact that all secular and long-period terms in the moon's revolution have their counterpart in the rotation; for example, the secular acceleration in longitude has not the effect of making us gradually see a different hemisphere.

Much attention has been given of late years to the "physical libration," especially the annual term, which is considerably the largest. Different determinations of its coefficient show a surprisingly large range; the largest value is that of M. Puiseux, 10·1′, derived from forty Paris photographs covering a period of fifteen years; the other values range from 5·7′ to 1·0′. We have to divide these figures by 220 to obtain the apparent shift seen from the earth. This gives 5·2″ for the Puiseux value; it does not appear that the numerous meridian observations of the crater Mösting A will permit of so large a value.

In studying the problem mathematically, the author makes use of some methods introduced by MM. Zinner and Charlier, which have appeared in earlier *Meddelanden*. He denotes the three principal moments of inertia of the moon by A, B, C. A is about the diameter pointing towards the earth, and C about the axis of rotation. The three ratios $(C-A)/A$, $(C-B)/B$, $(B-A)/A$, are denoted by k_1, k_2, k_3. It is shown that stability demands that B be greater than A, *i.e.* the moon's equator is elongated towards the earth; if k_1, k_2 have different signs, C lies between A and B, and the rotation is unstable. It is shown that k_1, k_2 may be either both positive or both negative; in the first case C, B, A are in descending order of magnitude, in the second case B, A, C; the latter would involve rotation about the longest axis, which is interesting as a theoretical possibility, but it is shown later not to be the actual case. Hence k_1, k_2 are both positive. k_1 is stated to be about 0·000627; the values of k_3 corresponding with the physical libration coefficients of Franz, Hayn, and Puiseux are 0·000314, 0·000157, and 0·001178 respectively. The last value makes k_2 negative, and therefore indicates unstable motion, another reason for concluding that the Puiseux coefficient is too high. However, it is shown that controlled rotation may exist, even when the conditions of stability are not satisfied.

[1] "Über die Rotation des Mondes." Von Axel Jönsson. *Meddelanden* of Lund Observatory, ser. ii., No. 15. (Lund: C. W. K. Gleerup, 1917.)

The suggestion has been made that the moon may not be a perfectly rigid body, but may have sensible change of shape under the varying strains; also that the interior may be partly fluid; the final chapter of the memoir discusses the changes in the equations of motion to which these hypotheses give rise, but does not express any opinion as to their tenability. The preceding chapter gives the numerical calculation of a large number of coefficients, using Brown's expressions for the moon's co-ordinates, and different assumptions for the values of k_1, k_2, k_3.

A. C. D. C.

ADAPTATION AND DISEASE.[1]

THE time has come to bring before biologists in general the contributions of medical research of the last quarter of a century to the study of evolution. The fact of evolution all thinking minds accept, but as to how evolution has been, and is being, brought about is a very different matter. The fight truly centres upon the cause or causes of variation—whether the tendency to vary is something inherent in living matter, numerous variations presenting themselves through this inherent tendency, of which those that are best fitted for their environment alone survive, or whether it is primarily and essentially brought about by forces acting from without upon a relatively labile living matter: whether, that is, variation is inherent, proceeding from within, or acquired, proceeding from without.

But this basal problem has been largely neglected by the biologists, the fight all these years waging round the secondary problem of the transmission of acquired properties to the offspring. Herbert Spencer made this transmission of acquirements one of his "principles." Weismann violently[2] opposed the doctrine, carrying with him latter-day biologists, until Mr. Bateson, replete with his studies upon Mendelism, reaches the antipodal suggestion that when a new property manifests itself in any individual of any species, it is impossible to regard it as an acquirement: it is not new, but its manifestation is due to loss of properties already possessed. Evolution, like a squid, progresses backwards, what appears to be a new property is on the contrary primeval. Prof. Bateson's address on Heredity at the International Medical Congress in London in 1913, and his Presidential address at Melbourne in 1914, were quoted *in extenso*. That which to outward seeming is the simplest form of life is verily in constitution the most marvellously complex: the higher forms of life are the lower.

The truth seemed to be that valuable and fascinating as are the studies for the establishment and amplification of Mendel's law, that law deals only with the interplay of allelomorphs, with the combinations and permutations of positive and negative unit properties possessed by the species. It only establishes the extent of variation possible *within the boundaries of the species*. But no amount of interplay of properties already possessed by the species will result in the production of individuals which are outside the species.

Sir Ray Lankester recently laid down that the one fallacy in all Lamarckian doctrine was that adopted by Herbert Spencer, namely, what he termed "direct adaptation." There is really no such thing. The supposed mysterious property of direct adaptation is always due to survival by selection of organisms which varied in many directions.

[1] Abstracts of four Croonian Lectures delivered at the Royal College of Physicians on June 14, 19, 21, and 26, by Prof. J. G. Adami, F.R.S., Temporary Lieut.-Colonel C.A.M.C.

[2] Sir E. Ray Lankester has in the *British Medical Journal* taken exception to the use of this word; the author agrees that "vigorously" better expresses his meaning.

Now if there be one fact that is constantly being impressed upon the student of immunity and the workers in pathogenic bacteriology, it is that direct adaptation, *i.e.*, specific modification in response to specific alteration in environment (within limits which he would lay down) is one of the basal phenomena of living matter. It seems useful, therefore, to marshal in order the data bearing upon these matters as they present themselves to those engaged in medical research.

Problems of this nature are *a priori* most likely to be solved by experiments upon the very simplest, and again upon the most complex forms of life. For problems of adaptation and heredity the bacteria possess the supreme advantages of rapid reproduction coupled (according to our present knowledge, or want of knowledge) with a complete absence of the disturbing influence of sex and conjugation. Certain biologists are unwilling to regard the products of asexual binary division as true generations. One very distinguished biologist had said that a long cultivation of a bacterial growth is "one continuous individual." This is an impossible position. The very idea of individual connotes independent, or potentially independent, existence. We might with equal logic, basing ourselves on the continuity of the germplasm, declare that all living beings constitute one continuous individual.

Adaptation in the Bacteria and the Evolution of the Infectious Diseases.

It is absurd to expand the Batesonian hypothesis and imagine that whenever man became man he acquired the germs of all bodily ills, and that the purely human ailments were already there. Some diseases, like tuberculosis, have been with us from the remotest historical times, and even from prehistorical, as witness the late Sir Armaud Ruffer's studies in palæopathology upon mummies of early dynasties, and the recognition of caries and pyorrhœa in permian fishes and tertiary three-toed horses. This is only to be expected. The bacteria are among the earliest of all forms of life. Drew, from his studies of the calcareous ooze of the Florida lagoons, showed that a dentrifying bacillus caused the deposition of chalk out of sea-water. Walcott has discovered Cyanophyceæ and possible micrococci in the oldest of all sedimentary rocks, the Algonkian.

But this does not mean that all orders of pathogenic bacteria and microbes have always been with us. Zymotic phenomena must run parallel with geological. The vast majority of fossils are remains of species and genera which have passed away, but certain species, and, indeed, certain genera, have existed unchanged through countless ages to the present day. The brachiopod Lingula of the Cambrian rocks is to be found to-day living buried in the sand between the tide-marks in the Tropics. The pearly Nautilus, Limulus, Ceratodus, and Anaspides have remained apparently unaltered for extraordinarily long periods of geological time.

The same would seem to be true with respect to zymotic diseases and their causative agents. Many of the plagues and epidemics mentioned by early writers are unrecognisable to-day. The tritest example of a disease which has come and gone is the malignant "sweating sickness," which, first noted in 1485, was last heard of in 1551. As regards diseases still with us, whatever view be taken regarding the origin of syphilis, it is certain that this was unknown in Egypt and in Rome at the time of Galen. Diphtheria and cholera, both with absolutely characteristic symptoms, were unknown in Europe until the beginning of the nineteenth century. Even if these

two diseases had been locally endemic for long periods in some districts, we may come to the same conclusion as is reached in many cases of the geographical distribution of animals and plants. When a form introduced into a continental area rapidly spreads over that area, its previous absence is to be explained as due to the fact that the form in question originated at some period after the separation of the different continental areas. In this very war two new diseases, hitherto unknown, have made their appearance—trench fever and trench shin.

How, then, can we picture to ourselves the evolution of an infectious disease? In the first place, it is to be noted that pathogenic microbes are singularly diverse in their affiliations—there is scarcely a genus of micro-organism but has its representative or representatives among the pathogenic organisms—moulds, yeasts, fission-fungi, spirochætes, filterable viruses and chlamydozoa, amœbæ, flagellate and ciliate protozoa. *Every pathogenic microbe has closely related species differing from it in little beyond that the one is virulent, the other not.*

Next, the allied species are found suggestively growing in the cavities or on the surfaces of the body in the same habitat as the virulent forms, or, again, in the water and foodstuffs taken by the animal. This leads to the conclusion that pathogenic microbes at some period or periods have originated from forms saprophytic on the body surfaces, or in the foodstuffs, that they have originated by adaptation of these forms to growth, not on, but within, the tissues.

We possess abundant examples of experimental adaptation of bacteria to new foodstuffs, to foreign sugars, glucosides, fats, etc., from Pasteur onwards. The observations of Penfold, Twort, Massini, and others upon the accustomance of bacteria to new sugars and their acquirement of the power of fermenting the same may be mentioned. The bacilli taking on these new powers were not mutants, the outcome of chance variation, but the acquired new property was definitely the result of a particular environment. Major F. B. Bowman has prepared a simple experiment which demonstrates that not some, but all, the members of a culture of bacilli, subjected to the same environment in a fluid medium of growth containing a foreign glucoside—isodulcite—acquire the new property.

Here, then, contrary to Bateson, we have evidence of positive acquirements from without, and, contrary to the Lankesterian dogma, we can so arrange our experiment as to obtain, not evidence of variation in many directions, but evidence that organisms placed in a given environment all vary in one identical direction with clockwork regularity.

If this be true regarding other properties, it must be true regarding the acquirement of virulence. As a matter of fact, Thiele and Embleton, at University College, had experimentally taken a harmless saprophytic form, the *B. mycoides*, accustomed it gradually to grow at the temperature of the body, and then, employing the dead bacilli to induce anaphylaxis and increased susceptibility, had, upon making a second injection, succeeded in obtaining the active growth of the bacilli in the tissues of the guinea-pig—and with this found that the bacillus was now virulent, killing other animals when injected into them. With these examples for consideration, is it possible for medical men not to believe in direct adaptation?

The Adaptation to Disease-producing Agencies in the Higher Animals.

It is in respect to these new acquirements in the higher animals that we obtain the deepest insight into the processes involved, and that through the abundant, not to say overwhelming, studies of the last thirty years upon immunity. Yet although every man and woman of the day discusses familiarly matters such as typhoid inoculation, diphtheria antitoxin, and tuberculin, not a single general biologist has dwelt seriously upon the significance of these studies. *Immunisation is direct adaptation.* Take the familiar examples (to medical men) of immunisation to the phytotoxins, abrin, the active principle of the jequirity bean, and ricin, of the castor oil plant. The rabbit and guinea-pig have never come across these in nature. They are, in fact, intensely poisonous. One gram of ricin is adequate to kill 1,500,000 guinea-pigs. Feed these small animals with minute and progressively increasing doses, and eventually they can be given 100 times the fatal dose. And now 1 c.c. of the blood serum of the immunised animal will destroy ten, one hundred, or one thousand times the fatal dose, according to the grade of immunity induced. Clearly, the blood serum now contains antitoxic substances, bodies which combine with the toxin, rendering it inert and harmless. The antitoxin has been elaborated and excreted into the blood by certain cells of the animal, and once these cells have acquired the property of elaborating an antiricin, they continue to produce it for weeks and months. Here is the acquirement of a new property—the acquirement is something positive, something added; there can be no alternative hypothesis of loss of inhibitory factors. Nor is it a chance variation: the power can be produced in any mouse or rabbit or guinea-pig with absolute certainty. Nor is it a matter of the survival of the fittest. The case of diphtheria and tetanus toxins, and the production of antitoxins against these toxins is absolutely parallel. The tissues can be educated to elaborate, and elaborate in excess, a body substance which neutralises the toxin, and, once started, they continue for weeks and months to elaborate the antitoxin. It has been shown that it is the cells that take up and fix the toxins which elaborate the antitoxins. It is, however, only a minority of the pathogenic bacteria that form and excrete ectotoxins, poisons which are discharged into the fluid of growth; the majority do not excrete toxic substance. Nevertheless the body can be immunised against these also, though here the immunity is of a different order. It is bacteriolytic—a process of digestion. The fluids of the body gain the power of dissolving and digesting these bacteria That power has been acquired by the millions of soldiers subjected to anti-typhoid inoculations.

This fact of the acquirement of a power on the part of the body fluids to digest the bacteria can easily be demonstrated. Every student of medicine has heard of Pfeiffer's reaction, in which the peritoneal fluid of a guinea-pig given progressive injections of the typhoid bacillus or the cholera spirillum, instead of forming a favourable culture medium for these bacteria now causes a rapid swelling up and dissolution, so that they melt away like sugar in water. Clearly, in the process of immunisation certain tissues of the body have gained the property of elaborating ferments which digest and dissolve the bacterial bodies, so that now, with little or no general reaction, the animal withstands many times the fatal dose of these pathogenic organisms. And this reaction is in general narrowly specific, so that it is employed to distinguish, for example, between closely related species of spirilla.

Nor is this necessarily merely a temporary acquirement on the part of the individual. For months after a man has been given one or two doses of dead typhoid bacilli his blood serum has a different physical constitution, or, as we are accustomed to term it, contains specific "anti-bodies"—agglutinins. The whole British Army now agglutinates the specific

bacilli of typhoid, paratyphoid A and paratyphoid B, and that for a year or more after inoculation of the soldiers. Smallpox, naturally acquired, usually confers a lifelong immunity. We here observe the working of a law which, if recognised, has not been dealt with adequately by biologists. In 1896 Wiegert, the Frankfort pathologist, laid down the law of inertia—the law that once a cell is stimulated to perform a certain act, it continues to perform that act for some time after the stimulus has ceased to be in operation. Here is something beyond mere inertia; the functional activity once started, at least in the order of events under consideration, continues too long to be comparable with physical momentum; rather there appears to be the setting in motion of a cyclic process of intercellular reactions and counter-reactions, the one starting the other. It is preferable, therefore, to employ a non-committal term, and to speak of the "law of habit." Of this law numerous examples may be given, both from among the bacteria and morbid states in man.

Next, to advance further, evidence obtained from medical research shows that acquirements, whether of defect or excess, are capable of being passed on to the next generation. There is abundant evidence of this in the case of the bacteria, and here the longer the environment has acted on a given species of microbe, the longer the microbe retains the impressed property, but as he could not state dogmatically that there is any biochemical property that is specifically fixed in these lower forms, still less could he regard any acquirement as being permanently fixed.

With regard to higher animals, difficulties are introduced by intra-uterine existence, so that the only clear cases to be considered are those in which the male parent alone has been subjected to the noxious or other influence. If the lymph contains soluble toxic substances, it is evident that the germ cells are not precluded from absorbing them, and, like the other tissue cells, from being influenced by them. There are many examples, clinical and experimental, of the effects upon the male germ cells of lead, nitrate of mercury, tuberculin, abrin, etc. The most conclusive observations are those of Prof. Stockard, of Cornell Medical College, New York, in which, by subjecting male guinea-pigs for some little period to the fumes of alcohol, he found not merely that the offspring were stunted and enfeebled, but that by crossing unrelated offspring of alcoholised fathers, which themselves had not been subjected to alcohol, the progeny of the third generation showed more extreme conditions of defect than did their parents. The importance of these observations upon the understanding of human family histories and inherited neuroses, etc., was very great.

The preceding are cases of what has been termed parallel induction. So long ago as 1901 the lecturer pointed out how what we now term the endocrine organs—the organs, that is, of internal secretion—are closely associated with the generative organs, and that influences from without acting upon these organs by causing an excess or defect of their internal secretions, are capable of affecting the germ cells, so that there is a definite possibility that the same order of disturbance which affects one or other endocrine organ of the parent may present itself in the offspring. Prof. E. W. MacBride has recently expressed the same opinion, and there is to be seen in this possibility or probability the solution of a long-standing difficulty, namely, the admission that there is one possible group of cases for which the Lamarckian theory holds true, and this, oddly enough, along the lines of Darwin's discarded hypothesis of pangenesis; only it is not by specific corpuscular pangens, but by diffused secretions that the germ cells are influenced.

The Physico-Chemical Basis of Immunity and Evolution.

It had been shown that the studies upon pathogenic bacteria and upon immunity prove conclusively the existence of direct adaptation of a definite order, both in the lowest and in the highest forms of life. It is along these lines that medical research is surely leading us.

Believing that workers in medicine are in the right, where is it that the other biologists have gone wrong? The latter, from the morphological trend of their studies, have perforce conjured up separate individual particles or structures, each the bearer of an individual property or group of properties. Their conceptions have perforce been in the terms of specific atomies. In his pangenesis hypothesis Charles Darwin evolved such a conception, and in his great sanity cast it aside. Weismann rioted in such, with his ids, idants, and determinants, all figments of the imagination. The same tendency is shown and carried forward in full vigour by the modern Mendelians.

Suppose we start, instead, from known facts and known phenomena, and upon these endeavour to build up our idea of the nature of the germ cell and of the organic basis of heredity. First, as to the constitution of living matter. We know that whatever form of life we investigate, animal or plant, mammoth or microbe, whatever form we analyse, or whatever tissue—leaving out of account water and certain vehicular salts to which no specific vital functions can be attributed—just one order of highly complex compounds is common to and to be isolated from all, and these are the proteins. This universal presence in itself indicates that they are intimately associated with vital functions. When isolated chemically they are inert; in other words, living matter contains proteidogenous, rather than proteid substances. Much attention has to be given to the study of the chemistry of the proteins in relationship to metabolism: the huge size of the protein molecule, close to the limits of visibility under the highest power of the microscope; its great molecular weight; the impossibility of gaining identical analyses of two samples of the same protein, even if, like hæmoglobin, crystallisable; the structure of these molecules; their dissociation into smaller complexes, the peptones; their further dissociation into amino-acids; the synthesis of the polypeptids. The protein molecules may, therefore, be represented as a ring or chain of linked peptone molecules, each having its ring of glycocoll nuclei with swinging side-chains. In the much simpler bodies with which the organic chemist is in the main concerned, bodies like the carbohydrates or the benzol derivatives, we know how the transfer of a given radicle from the *alpha* to the *delta* position, for example, upon a ring may bring about a profound change in the chemical and physical properties of the compound. When two carbon atoms are united together there are, or may be, six free affinities, and when these are satisfied by six different monovalent groups, twelve different isomeric arrangements are possible. What must be the possibilities in a protein like hæmoglobin, with 700 and more carbon atoms in the complex, and hæmoglobin is simple compared with the nucleoproteins.

If the biophores, or molecules of living matter, be at least proteidogenous, obviously it is not necessary to demand a separate determinant, a separate molecule for each specific property; it is simpler to regard properties inherent in the biophores as an expression of the constitution of the same, of the mode of linkage of the various nuclei, their number, and the nature of their side-chains. This conception is within the bounds of physical possibility; Weismann's ids and idants certainly are not.

Accepting this conception of the chemical constitution of the essential living matter as a working hypothesis, we know that in conjugation the one constituent of the germ cells contributed in an approximately equal portion by both parents to the zygote, or fertilised ovum, is the nuclear chromatin, and as heritage of properties may come equally from either parent, in the nuclear chromatin must reside the main heritable and character determining material. The conclusion is inevitable that the essential biophoric molecules are conveyed in the nuclear chromatin. The cell-wall, the cytoplasm, and the nuclear membrane are all conservative agents, tending to preserve the biophores from sudden change from without, but, while conservative, this system is exposed to constant change, particularly in the more active tissue cells. The system is not inert, but is constantly reacting with the external medium in which the cell finds itself. The semipermeable cell membrane, while preventing the entrance of some substance, freely permits the entrance of others, whether directly or after a preliminary dissociation into smaller molecules by the action of extracellular enzymes. Once foodstuffs are taken into the cytoplasm they are, if necessary, broken down into yet simpler molecules by intracellular enzyme action. Foodstuffs are not utilised by the cell as such, but only after dissociation and disintegration, and then either by oxidation to supply energy or, on the other hand, to be built up in growth.

This matter of growth is wholly neglected by the other biologists. They speak of inorganic bodies (crystals) growing by agglutination, organic bodies by intussusception. "Intussusception," "imbibition," "intercalation," and "interpenetration," are all inane terms; they cannot possibly explain how two molecules of living matter appear where there was but one before, two grains of wheat where but one was put into the ground. Growth is one of the great underlying phenomena of living matter, and zoologists and botanists have in a simple Topsy-like manner been satisfied that the phenomena occurs—and have left it at that. Increase in the amount of living matter means multiplication of the molecules of living matter, and this multiplication can only take place after the manner of the growth of a crystal, by ions arranging themselves into radicles, and radicles arranging themselves in a particular order, until in orderly sequence the necessary radicles become built up, identical in arrangement with the pre-existing molecule, in association with which the group has become developed. This conception is materially aided by the recognition that crystallisation does not of necessity demand the production of rigid rectilinear figures. Lehmann in 1904 first directed attention to the existence of "fluid crystals"; in 1906 Adami and Aschoff pointed out that these fluid crystals are frequent in the animal organism. As D'Arcy Thompson remarks, "the phenomenon of liquid crystallisation does not destroy the distinction between crystalline and colloid forms, but gives added unity and continuity to the whole series of phenomena."

Weismann's doctrine of the continuity of the germplasm is erroneous; it is not the germplasm which is eternal; merely there is a potential continuity of molecular arrangement and constitution. The functional and vegetative activities of the organism and the cell, along with the essential nature of metabolism and enzyme action, emphasise that these matters of adaptation and evolution have to be approached from the aspect of function and the dynamics of living matter, rather than from the point of view of cell statics. "Function precedes structure," and the study of cell function must afford the key.

As regards the acquirement of the new power of digesting and utilising a foreign protein, it is seen from what has been said that these proteins are complexes of amino-acids; and the number of the individual amino-acids is limited. Proteolytic enzymes, already in existence, whether intra- or extra-cellular, do not attack the foreign protein as a whole, but must be regarded as dissociating certain everyday amino-acids from the complex. But doing this, to take the simplest case, the relative number of molecules of the different amino-acids presented to the cell may come to differ from the normal, or, again, the simpler complexes due to the breaking down of the foreign proteins may not be identical in constitution with those which the cell and its biophores had been accustomed to utilise in growth. In either case the constitution of the biophores may become altered as they are built up. Where enzyme-like bodies, such as the toxins and phytotoxins, become introduced into the cytoplasm, their toxic function must be regarded as due to their power of dissociating the living molecules, by detaching certain radicles. If the toxic molecules be not present in too great a number, time is given for the living molecules to attract and build up again the lost radicles, and by the law of habit, if this process be constantly repeated, particular radicles are now to be built up in excess of the needs of the cell, and, undergoing discharge, become the antitoxin bodies of the blood and body fluids.

That this conception of the mechanism of immunity and progressive adaptation is substantially correct was strongly supported by the long-continued and admirable studies of Prof. V. C. Vaughan, of the University of Michigan, and the later work of Abderhalden, of Berlin, and his pupils.

The prevalent conception of the Mendelians that the parental properties remain segregated in the germ cells is open to attack. In the zygote, the fertilised germ cell, and in all the tissue cells derived therefrom, it is inconceivable that two orders of biophores, or active living molecules, can exist floating in a common nuclear sap, undergoing growth, building up side-chains and radicles, discharging certain of these, or undergoing dissociation from time to time, without the two reacting upon each other, and without a certain amount of interchange, without the one having a greater affinity for side-chains elaborated by the other and building these into its system. There must be this interaction, and at a slower rate, due to their more latent state, this same interchange must take place in the germ cells. Along these lines it is still possible to interpret the facts of Mendelism, and, indeed, interpret not a few phenomena which by the hypothesis of determinants fail to obtain explanation.

Briefly, each species must be regarded as having for its essential living matter a distinct organic compound, a compound as distinct as any inorganic salt, but differing from that simpler salt in that whereas the central ring, or chain, is to be regarded as having a relatively fixed constitution, the radicles composing that ring or chain are to be regarded as capable of attracting and then reproducing a series of side-chains which may vary in constitution, so that within the species there may be various strains, just as we may speak of various strains of crystalline hæmoglobin obtained from different samples of human blood.

It is possible to replace an impossible hypothesis based upon supposititious independent and transposable determinants by one based upon our present knowledge of the composition and properties of the main and outstanding constituent of living matter—the proteins. To one who regards life, not from the morphological point of view, in terms of form, but from the physiological, in terms of function, who regards life as a moving equilibrium, who regards it as in essence

"a state of persistent and incomplete recurrent satisfaction and dissatisfaction of certain proteidogenous molecules," and metabolism as the primary and basal characteristic of living matter, for such a one Prof. Bateson's stumbling-block does not exist.

The hypothesis of a backward evolution by the progressive removal of inhibitory factors, like the baseless fabric of a vision, fades into nothingness once it is confronted by the proof that direct positive acquirements can be brought about experimentally. It enters into the limbo of the past as an example of the Spencerian tragedy—that of a deduction destroyed by a fact.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—M. L. de la Vallée Poussin, professor in the University of Ghent, is to act temporarily as lecturer in Sanskrit and Tibetan at the School of Oriental Studies.

THE Gladstone memorial prize of the London School of Economics and Political Science has been awarded to Miss Olive Wright.

SIR W. WATSON CHEYNE, Bart., has been elected Parliamentary representative of the Universities of Edinburgh and St. Andrews.

MR. ARTHUR T. BOLTON has been appointed curator of Sir John Soane's Museum, Lincoln's Inn Fields, in succession to the late Mr. W. L. Spiers.

MAJOR F. C. PURSER has been elected to the chair of the Theory and Practice of Physic in the Schools of Surgery of the Royal College of Surgeons in Ireland.

DR. A. W. ASHTON has been appointed principal of the mechanical and electrical engineering department of the Stoke-on-Trent Central School of Science and Technology.

DR. W. H. WELCH has resigned his position as head of the department of pathology at Johns Hopkins University to take up the directorship of the School of Hygiene and Public Health. Dr. W. G. McCallum, of Columbia University, succeeds him at Johns Hopkins University.

APPLICATIONS are invited for a limited number of places in the Pilcher Research Laboratory attached to Bedford College for Women, Regent's Park, N.W.1. Places are available for post-graduate work in science or in arts, preference being given to research in science, and, at the present time, to any investigation connected with the war. Applicants must state their qualifications, the nature of the research, and the period for which application is made. Further information may be obtained from the principal of the college.

MANY letters have been received by the chairman of the British Prisoners of War Book Scheme (Educational) testifying to the usefulness of the scheme. Further contributions are urgently needed. In the technical and scientific sections the prisoners' demand for books is very large, but the works asked for are rarely obtainable as gifts, as the owners generally need them for their own use, while second-hand copies, sufficiently up to date, are proving increasingly difficult to procure. In these circumstances the committee is compelled to make large purchases of new copies of up-to-date books of the above character, and, for this, ample funds are essential. Donors to the scheme will recognise that their gifts do not merely help to save the prisoners from mental starvation, but also increase their value as a commercial and professional asset after the war. Offers of books (which should always be accompanied by a detailed list) are also invited and should be addressed to Mr. A. T. Davies, C.B., "Prisoners of War," Board of Education, Victoria and Albert Museum, South Kensington, S.W.7.

SPEAKING last week at the Oxford summer meeting of university extension and other students, Prof. W. H. Perkin said that certain industries, which at one time appeared to be firmly established in this country, had left them to flourish abroad, and inquiry into the reason for this resulted in the conclusion that the cause of our failure had been our neglect of scientific methods and lack of appreciation of the value of research. At the commencement of the war Germany had, roughly, ten times as many advanced students engaged in research work as there were in this country. It must be clear to everyone that we could not hope to compete with Germany while such a state of things existed, and it was entirely due to our lack of appreciation of the importance of research that so many of our industries had already gone to Germany and so many were in process of being transferred when the war broke out. But in tackling and solving difficult manufacturing operations it was not too much to claim that the scientific men in our universities had shown how valuable they could be to the manufacturers, whether it be in connection with munitions of war or in the development of purely industrial operations. There could be no doubt that the war had already brought about this welcome change—that a much closer association between the manufacturer and the scientific worker was growing up, such, indeed, as had not previously existed in this country. There were, of course, not a few who were afraid that the introduction of work of industrial importance into our universities, and especially into such universities as those of Oxford and Cambridge, would have a bad effect on these institutions. They feared that the lofty academic spirit which had always pervaded our older universities would suffer from contact with the realities of commercial life, and while he could understand the suspicion which was always associated with any radical change in old-established traditions, he failed entirely to see why the introduction into the students' career of some of the conditions of the life which so many must ultimately adopt should be in any way prejudicial. He was certain that purely academic work and industrial research could go along side by side to their great mutual advantage.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 23.—M. Paul Appell in the chair.—Ch. **Lallemand**: Remarks on the extension to the sea of hourly time zones. The extension to the sea of the system of hourly zones in use on land, suggested in January last by J. Renaud, has been adopted by France for warships and mobilised vessels, and the Service Hydrographique de la Marine has published a planisphere of the hour zones. In Great Britain a committee appointed by the Admiralty has unanimously recommended the adoption of the same rules for British ships.—E. **Haug**: The extension towards the west of the strata of Basse-Provence.—M. **Leau**: The measurement of linear ensembles.—M. **Tournier**: The experimental determination of the efficiency of marine engines and boilers.—V. **Valcovici**: The position of the point of arrest in movement of uniform rotation.—J. C. **Solá**: A new stream of stars in Sagittarius.—A. **Guébhard**: A new manner of regarding volcanic action and the pseudo-eruptive ap-

pearances of granite.—M. **Dalloni**: The facies of the Lower Miocene to the south of Tell and the fauna of the Cartennian of Uzès-le-Duc, Algeria.—(The late) A. **Cochain**: Considerations on volcanic action.—C. **Sauvageau**: The proper motion of the chromatophores.—M. **Molliard**: The artificial production of a gall.—V. **Galippe**: Normal parasitism and microbiosis.—W. T. **Porter**: Observations on traumatic shock. It is shown that the increase of respiration produced by the administration of carbon dioxide is of great service in cases of shock; three examples of this treatment following severe operations are cited in which good results were obtained.

WASHINGTON, D.C.

National Academy of Sciences, Proceedings, vol. iii., No. 6 (June 15).—H. **Nyquist**: The Stark effect in helium and neon. An improvement of Lo Surdo's method is applied.—F. W. **Clarke** and R. M. **Kamm**: New analyses of Echinoderms. A progressive enrichment in magnesia, following increase of temperature, is unmistakable.—C. B. **Davenport**: Utilising the facts of juvenile promise and family history in awarding naval commissions to untried men. A study, with family charts, of a number of naval officers.—Gladys A. **Anslow** and Janet T. **Howell**: The triplet series of radium.—C. **Barus**: The measurement of small angles by displacement interferometry.—S. **Flexner**: Mechanisms that defend the body from poliomyelitic infection, (*a*) external or extra-nervous, (*b*) internal or nervous. A report upon the results of recent experiments.—J. B. **Brinsmade** and E. C. **Kemble**: The occurrence of harmonics in the infra-red absorption spectra of diatomic gases. The discontinuities in the structure of these bands force the conclusion that the angular velocities are distributed among the molecules in the discontinuous manner predicted by the older form of the quantum theory, and the proved existence of harmonics is almost equally good evidence that the vibrational energy of the molecules is distributed in the same manner.—W. **Wilson**: The loss in energy of Wehnelt cathodes by electron emission. The emission of the electrons from Wehnelt cathodes is due to a similar mechanism to that causing the emission from heated pure metals.—E. C. **Miller**: Daily variation of water and dry matter in the leaves of corn and the sorghums. Under the conditions of these experiments the sorghums, particularly milo, absorb water from the soil and transport it to the leaves more rapidly in proportion to the loss of water from the plant than does corn, and thus the sorghums can produce more dry matter for each unit of leaf area under severe climatic conditions than can the corn plant.—C. **Barus**: Note on complementary Fresnellian fringes.—C. **Barus**: The displacement interferometry of long distances. In preceding notes two methods for measuring small angles have been suggested. Application is here made to the determination of distances, and it is shown that an object at about a mile should be located to about 30 ft.

BOOKS RECEIVED.

Morphology of Gymnosperms. By Prof. J. M. Coulter and Prof. C. J. Chamberlain. Revised edition. Pp. xi+466. (Chicago: University of Chicago Press.)

The Nutrition of Farm Animals. By Dr. H. P. Armsby. Pp. xvii+743. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s.* net.

A First Course in Higher Algebra. By Prof. H. A. Merrill and Dr. C. E. Smith. Pp. xiv+247. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

Dutch N.W. New Guinea: A Contribution to the Phytogeography and Flora of the Arfak Mountains, etc. By L. S. Gibbs. Pp. iv+226. (London: Taylor and Francis.) 12*s.* 6*d.*

Le Paludisme Macédonien (Collection Horizon). By P. Armand-Delille, P. Abrami, G. Paisseau, and H. Lemaire. Pp. viii+109. (Paris: Masson et Cie.) 4 francs.

Problems in Dynamics (with Full Solutions). By Atma Ram. Pp. 245+diagrams 16. (Lahore: Atma Ram and Sons.) 3 rupees.

The National Food Supply in Peace and War. By Prof. T. B. Wood. Pp. 44. (Cambridge: At the University Press.) 6*d.* net.

A Defence of Idealism; Some Questions and Conclusions. By M. Sinclair. Pp. xxi+396. (London: Macmillan and Co., Ltd.) 12*s.* net.

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THURSDAY, AUGUST 23, 1917.

NEW BOOKS ON PLANTS.

(1) *The Principles of Plant-Teratology.* By W. C. Worsdell. Vol. ii. Pp. xvi+296+plates 26–53. (London: The Ray Society, 1916.) Price 25*s*. net.

(2) *Plants Poisonous to Live Stock.* By H. C. Long. ("Cambridge Agricultural Monographs.") Pp. vi+119. (Cambridge: At the University Press, 1917.) Price 6*s*. net.

(3) *Herbs Used in Medicine (First Series), with Descriptive and Explanatory Notes.* By Mrs. J. D. Ellis. Pp. 32. (London: National Herb-growing Association, 1917.) Price 3*s*.

(4) *British Wild Flowers: Their Haunts and Associations.* By W. Graveson. Pp. xv+320. (London: Headley Bros.) Price 7*s*. 6*d*. net.

(1) IN our notice of the first volume of Mr. Worsdell's "Principles of Plant Teratology". (NATURE, February 22, 1917) reference was made to the scope of the work and to the author's views as to methods of morphological investigation. The second and final volume deals with the flower of the vascular plants, the term "flower" including not only the flower of Angiosperms, but also the "cones" of Gymnosperms and vascular cryptogams and the sporophylls of ferns.

There are three main sections, entitled "Differentiation," "Simplification," and "Adventitious Flowers." Under the first head are grouped the following phenomena: Proliferation; forking and fasciation; disruption, a term applied to the splitting of the maize-cob, a female inflorescence, into the constituent branches which are normally united to form the cob; positive *dédoublement*, including increase in number of the members of a whorl (polyphylly) and increase in number of the whorls (pleiotaxy); dialysis, splitting or dissociation of members; and metamorphosis. Simplification includes abbreviation of the inflorescence and flower, adnation of floral axes or floral leaves, cohesion and suppression. Adventitious flowers are rare: a few cases are cited, and the remarkable instance of the Nepaul barley is described.

Most of the phenomena described under Differentiation are regarded as reversionary, though a number of those due to metamorphosis are recognised as progressive. The flower is considered as evolved from an elongated leafy shoot, the cone forming an intermediate stage; hence proliferation, which involves an elongation of the axis beyond the normal, is a reversionary process. On the other hand, granting that "simplification" of the flower by means of cohesion and suppression of its members represents one of the main processes of floral evolution, teratological phenomena of cohesion and suppression are regarded as progressive in nature, while those involving dissociation are reversionary. The splitting to a greater or less degree of the corolla of a gamopetalous flower into its component petals is not unusual, as, for instance, in Campanula; this is a case of reversion, because the flower with united petals represents a higher state of evolution than the flower with free petals. On the other hand, the reverse phenomenon of union of petals which are normally distinct is progressive. But does it represent anything more than mere terminology to call one of these instances progressive and the other reversionary? And is there any reality in the suggested relationships?

The study of plant abnormalities is full of variety and interest, and rich in surprises; to have prepared a book of reference on the subject is to have earned the gratitude of one's fellow-botanists. But Mr. Worsdell's work would have claimed a higher position if fewer pages had been devoted to theorising; the *rôle* of the recorder is an eminently useful one.

(2) Mr. Long's book on plants poisonous to live stock in the United Kingdom forms a handy work of reference in a subject on which the literature is remarkably scattered. The author has brought together many facts from numerous technical reports and journals, and the compilation will be of great value to those responsible for the care and treatment of animals. The plants included are more or less common wild plants which might be eaten by grazing animals or be mixed with fodder, but reference is also made to common ornamental plants known to be dangerous, such as laburnum, rhododendron, and cherry laurel; and poisonous leguminous plants, such as Indian peas (*Lathyrus sativus*), Java beans (*Phaseolus lunatus*), and lupines, are described at length. Excepting ergot, fungi are not included.

Poisonous plants differ widely in degree of harmfulness, and it is probable that under ordinary conditions many of the plants commonly regarded as poisonous are almost or quite harmless. In a state of nature animals appear to avoid toxic or unwholesome plants and to be less readily poisoned than are domesticated animals. Individuality is also a factor, some animals having a depraved appetite for unusual and unappetising food plants. The author quotes a remark of two American writers, that "there seems to be no way of accounting for the appetite or taste of stock." This statement is perhaps especially true of sheep, which will eat greedily on one day plants which they could scarcely be persuaded to eat on the following day on the same range of hills. The toxic properties of the plant are often affected by conditions of soil, climate, and cultivation; for instance, *Solanum nigrum*, an almost cosmopolitan weed, varies so much that it has been regarded as harmless in one country and poisonous in another. Again, a plant may be poisonous in all its parts, *e.g.* meadow saffron; or one part alone may be toxic, as the seeds in corn cockle. Frequently, as with buttercups, there are variations in the poisonous character according to the season, and some parts of the plant are more toxic than others; the flowers are the most poisonous, and then the leaves and stem.

The plants are arranged in systematic sequence under their respective families. Evidence for in-

cluding the plant as poisonous is given in each case, the toxic principle is described, as are also the symptoms, and references are given to the bibliographical list at the end of the volume. A short chapter is devoted to plants which lie more or less under suspicion of being poisonous, and there is also a brief account of the effects of wild plants on milk.

(3) Mrs. Ellis has written some useful descriptive text to a series of sixteen good coloured drawings by Miss Ethel Barlow illustrating some of the common herbs used in medicine.

(4) Mr. Graveson writes for the general reader. In a series of twenty-eight chapters he describes as many flower-rambles made between March and September. His style is discursive, but conveys some information on the life-history of the commoner wild plants. There is a good deal of "folk-lore" derived from well-known sources, and also plenty of quotations from the poets. The best feature of the book is the series of plant-sketches by Mr. J. Wood, which are included in the form of full-page plates.

IS THE ANGLO-SAXON DOOMED?

The Passing of the Great Race; or, The Racial Basis of European History. By Madison Grant. Pp. xxi+245. (London: G. Bell and Sons, Ltd., 1917.) Price 8*s*. 6*d*. net.

IN this work Mr. Grant takes up a theme which was broached by Dr. Gustav Retzius in his Huxley lecture to the Royal Anthropological Institute in 1909. In speaking of the two competing types of European—the tall, long-headed, blue-eyed Nordic type, and the short, round-headed, dark-eyed Alpine type—Dr. Retzius expressed himself thus:—

"There may lie in the circumstances to which I have called attention a very real danger of the North European dolichocephalic race not being able to hold its own. Just as it has been ousted during the past thousand years from Germany and other countries in Central Europe by the dark-haired, small-statured brachycephali, so, too, will it probably have to yield place here [England] and be reduced in numbers; perhaps by degrees disappear entirely out of the fatherland of their ancestors, by reason of the ever-increasing might and power of industrialism, with which they seem ill-fitted to cope successfully in the long run. The prospect is depressing, it cannot be denied, but the development of things in the world is not seldom harsh and unmerciful." [1]

That is the opinion which an excellent representative of the Nordic type formed of the future of his race in Europe. In a broad way Mr. Grant's book deals with the fate of the Nordic type in the United States of America, and from stray statements, which appear in a somewhat disjointed manner throughout its pages, we gather that the future of the Nordic type is as sombre in America as in Europe. "One often hears the statement made," writes Mr. Grant, "that native Americans of colonial ancestry are of mixed ethnic origin. This is not true. At the time of the Revolutionary War the settlers in the thirteen colonies were not only purely Nordic, but also purely Teutonic, a very large proportion being Anglo-Saxon in the most limited meaning of that term."

[1] Journ. Roy. Anthrop. Institute, 1909, vol. xxxix., p. 300.

Mr. Grant evidently uses "Teutonic" as a term for men of the Nordic type inhabiting modern Germany, and forming less than a sixth of the population of that Empire, but as "Teutonic" in ordinary language has come to be equivalent to German, it would be a scientific gain if anthropologists could agree to apply the term "Teutonic" for the designation of the round-headed, fair-haired non-Nordic prevalent and predominant German racial type. That, however, is a side-issue; the main matter is that everyone who has investigated the problem will agree with Mr. Grant that the men who secured the United States (and Canada) as a home for white men were almost a pure embodiment of the Nordic type. We expected Mr. Grant to give us the results of systematic inquiries and exact figures as to the prospects of the type in the modern population of the United States. We know how in recent years millions of the competing dark-haired, round-headed type have left Central Europe and crowded into the manufacturing centres throughout North America. "Our immigrants now," says Mr. Grant, "largely represent lowly refugees from persecution and other social discards. . . . European Governments took the opportunity to unload on careless, wealthy, and hospitable America the sweepings of their jails and asylums."

Races from the shores of the Eastern Mediterranean are crowding into the Southern States; the negro is more prolific than the native white man. "As in all wars since Roman times," so Mr. Grant avers, "the little dark man is a winner from the breeding point of view." There are ample and trustworthy statistics to prove that the descendants of the original colonists are much less prolific than other and different human stocks which have recently arrived in America. It must be admitted that there is a danger of the fair heritage gained by the enterprise and courage of the Nordic pioneers—a heritage in which the best traditions of Anglo-Saxon life were established—passing to a type of man that the early colonists would not have shed a drop of their blood to save. It is just for that reason we wish that the author of this book had stated his case somewhat differently in a work which has the alluring title, "The Passing of the Great Race." A. K.

ANOTHER TEXT-BOOK OF HISTOLOGY.

A Text-book of Histology. By Prof. H. E. Jordan and Dr. J. S. Ferguson. Pp. xxviii+799. (New York and London: D. Appleton and Co., 1916.) Price 15*s*. net.

THE appearance of another text-book dealing mainly with human histology and obviously designed chiefly for medical students naturally

invites attention to the points wherein it differs from previous text-books on the same subject. Although histology, like every other branch of biology, continues to progress, yet in such a limited and well-explored field as human histology a nearer approach to finality has been reached than in any other branch of biology, and therefore the need for a new text-book is less obvious.

We may say then at once that Prof. Jordan and Dr. Ferguson have produced an eminently *handy* text-book. Its bulk has been limited not only in the matter of number of pages, but also in the not less important respect of size of page, and its weight is still further reduced by the type of binding adopted, which, oddly enough, resembles that which has long been popular in the case of copies of the Bible. The plan of the book follows the well-known lines familiar in most text-books of histology, viz. the various types of tissues are dealt with seriatim and then an account of the structure of the principal organs of the body is given. Since, as we have already noted, there is an evident determination on the part of the authors to keep the size of the book within modest limits, the essential facts are stated as shortly and succinctly as possible, and although the student is made aware of conflicting views on points where uncertainty exists, yet no space is wasted in prolonged discussion of such disputes.

What, however, is more prominent in this work than most similar text-books, and what strikes us as wholly admirable, is the presence of numerous explanations of the *functions* of the structures described. After all, one main reason why histology is studied is for the purpose of elucidating function, and what might easily become a mass of wearisome detail to the student becomes lighted up with interest when he is made to understand what the structures are for.

A feature of great importance in any text-book of histology is the nature of the illustrations, and in this matter we regret to say that in our opinion the authors have followed a wrong method with regard to many of these. A large proportion consist of half-tone reproductions of photographs of actual sections. Such figures are in our opinion most unsatisfactory, for there is inevitably much blurring of outlines. If it be urged that it is important to represent what a student will actually see in the specimen and not the teacher's interpretation of it, we may rejoin that this is precisely what photographs do *not* show. The distinctions produced by differential staining are lost, and no one ever looks at a section without continually turning the fine-adjustment screw of the microscope and bringing various levels of the section in turn into sharp relief, whereas the best photograph reproduces clearly only the structures that lie at a single level. The large proportion of the photographic figures seriously detracts from the merits of the book. On the other hand, the insertion of a considerable number of simple outline explanatory diagrams, such as those of the embryonic development of the pancreas and the descent of the ovary, are of great assistance. As is perhaps natural in American authors, the references cited relate too exclusively to the results of American workers. On the whole, however, the clearness of the descriptions, the emphasis of essential points, and the neglect of secondary details combine to make this in our opinion a valuable text-book.

E. W. M.

OUR BOOKSHELF.

A Pocket-book for Chemists. By T. Bayley. Eighth edition. Edited by R. Ensoll. Pp. xvi+425. (London: E. and F. N. Spon, Ltd., 1917.) Price 7*s*. 6*d*. net.

The "Chemist's Pocket-book" by T. Bayley, of which the last and seventh edition was published in 1900, has served for many years as a useful laboratory companion. In this new issue, edited by R. Ensoll, the contents of the previous edition have been rearranged, much obsolete matter has been omitted, and a number of tables have been added.

The subject-matter is grouped under the headings of (1) mathematical data; (2) weights and measures; (3) physical data; (4) general analysis; (5) gravimetric analysis; (6) volumetric analysis; and (7) miscellaneous. The first three sections contain a comprehensive series of useful data of reference, conveniently arranged in tabular form. In the section on general analysis the methods described are restricted to the analysis of sugar, wine, beer, spirits, and milk, and to a number of examples of indirect analysis, a selection which seems to bear but little relation to the requirements of the average chemist. The tables of factors included in the section on gravimetric analysis have been carefully chosen and are well arranged. Some of the methods of standardisation described in the section on volumetric analysis could be revised with advantage, as they are not fully in accord with those of modern analytical practice. The concluding section, "Miscellaneous," contains a number of data, such as instructions in bending and cutting glass tubing, cleaning laboratory vessels, etc., which seem peculiarly out of keeping with the proper objective of the book. In future editions the space thus occupied could be advantageously made use of to extend other portions of the contents. This re-issue, which is published in the form of a handbook, has been very carefully edited and is likely to maintain the utility of the earlier editions.

C. A. K.

Food. By Dr. A. Hill. ("Manuals of Health," No. 1.) Pp. 64. (London: S.P.C.K., 1917.) Price 9*d*.

Food is a subject of predominant interest at the present time, and it is important that sound knowledge concerning its use and function should

be widely and assiduously disseminated. In the main Dr. Hill's book is a useful contribution towards this object.

In chap. i., on "The Need of Food," the author has put the case clearly, though some improvements might be suggested. The calorimeter illustrated, for instance, is far removed from that actually used. Nor is it strictly accurate to say that the body must receive as much nitrogen as the kidneys excrete in urea. What really happens is that the kidneys excrete as much urea as is presented to them to be eliminated, this amount being no trustworthy measure of the nitrogen needs of the body.

In chap. ii. an attempt is made to give a simple account of the chemistry of food. It is doubtful if it is worth its place.

The main part of the booklet is devoted to a consideration of the nourishing value of various foods. The information is on the whole sound, though in many ways this chapter could be shortened with advantage. Some statements also require qualification, such as that the presence of sugar with protein in the stomach leads to a formation of uric acid in the system; that "gelatin cannot take the place of protein" (p. 35); that "gastric juice does nothing to break up the fat-saturated lumps" of flour and butter in pastry (pp. 36 and 37); and that no other kind of food gives so good a return for its cost as cheese.

Too much stress also is laid on the content of protein in a food as a measure of its nutritive value, and the author argues too rigidly from the assumption that a working man requires 4 oz. (113·5 grm.) of protein per day in his diet.

On p. 13, by oversight, a man's weight—75 kilos—is translated as 13 st. 9 lb., whereas it should be 11 st. 11 lb.

The booklet should prove useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Terminology of Parthenogenesis.

THE word "parthenogenesis" has become established in biological science to signify the production of offspring by a virgin mother. The term does not embrace reproduction by buds or by fission, but refers to parentage by a mother who produces egg-cells similar to those which are, in the vast majority of instances, fertilised by male sperm-cells before proceeding to develop. In these instances (distinguished as instances of "parthenogenesis") the egg-cells proceed to develop without fusion with the male reproductive element or sperm-cell.

Parthenogenesis may accordingly be defined as an exceptional and historically super-induced modification of the normal process of sexual reproduction or gamogenesis in which the female gamete or egg-cell does not unite with a male gamete or sperm-cell to form a "zygote," but proceeds to develop independently.

The term should not be applied to reproduction by unfertilised unicellular "spores" common in the lower plants and protozoa, nor to any cases except those in which the "parthenogenetic" reproductive cell is *either* (1) a normal egg-cell capable of sexual zygosis, *or* (2) demonstrably a comparatively recent modification of such an egg-cell. The latter is an important special group, and at one time these modified egg-cells—*incapable of fertilisation* were incorrectly described as "pseud-ova" (Huxley). The egg-cell thus independently developing may be described as "autoblastic" and the process as "autoblastesis." And again the autoblastic egg-cell may be described as "lipospermic" and the embryonic history as one characterised by "lipospermy" or "lipospermia."

A difficulty of nomenclature has lately arisen in describing and discussing the offspring so produced—for instance, when the eggs of the frog have been experimentally induced by the mechanical method of Bataillon (scratching with a needle) to develop so as to give rise to tadpoles, and even adult frogs, without fertilisation by sperm-cells. By oversight the tadpoles so produced have been referred to as "parthenogenetic," and by a similar error the broods of greenfly produced without the intervention of a male parent have been called "parthenogenetic young." Clearly the word "parthenogenetic" has been, and must be, used to describe the virgin mother, and therefore cannot at the same time be applied to her offspring without causing confusion. It seems to me that the word "impaternate," or "fatherless," should be used for the offspring. I have failed to excogitate any other term which will so well meet the case.

If we call individuals so produced "autoblastic"—a term applicable to the egg-cells which give rise to them—we leave it doubtful as to whether we may not be referring to their *future* reproductive capacity rather than to their origin; and if we call them "lipospermic" we may possibly intend by this word to indicate that they are devoid of male reproductive gonads, and not merely that no sperm-cells were concerned in their genesis. The term "impaternate" is readily intelligible and admits of no such ambiguity.

A further difficulty in regard to the nomenclature of virgin reproduction or parthenogenesis is that the word "virgin" and its Greek equivalent refer to the condition of the *mother*, and not to the history of the *egg-cells* which she produces and passes from her body. The "virgo intacta" is an adult female who has not been "covered" or "impregnated" by a male, or, to use another term, has not been "mated." In most species of frogs and fishes, and in many other aquatic animals, *the female parent is always a "virgo intacta."* Such females are always "parthenogenetic" in the strict sense of the word. The fact that the eggs are not "autoblastic," but are fertilised after they leave the mother's body, does not alter *her* physiological condition or "status" in any way as compared with that of a mother whose eggs on being deposited by her are capable of "lipospermic" embryogenesis. She is never "mated" or "impregnated." The difference between her and the more familiar impregnated or fecundated mother arises from the persistence in the one case of the original and primitive method of free discharge of both the female and the male reproductive cells into the water in which the parents live, and, by contrast, the secondary development in the other case (comprising a vast variety and number) of arrangements for the fertilisation of the egg-cells while still actually within the *protective* body of the mother or in close contact with it. These secondary develop-

ments are determined by the fact that they favour both economy and certainty in the operation of the male gametes or spermatozoa, and by their provision of advantageous maternal protection to the minute egg-cells and the early stages of their growth when fertilised. In non-aquatic animals intra-maternal fertilisation of the egg-cells is obligatory.

The egg-cells which are freely discharged and fertilised by free-swimming sperm-cells "in the open" may be called "*planktogamic*" (plankton = freely swimming), whilst egg-cells which are subjected to the secondary protective arrangements may be called either "*hysterogamic*" (hysteron = uterus), if fertilised within the oviductal chamber of the mother, or "*propylogamic*" (propylon = a gateway), if fertilised on the surface of the mother's body or in immediate relation thereto (as in the case of many Crustacea and of some Amphibia).

There is no word in use to indicate the physiological status of an adult female which is no longer a "virgin," but has been "mated" or "covered," and has received into her oviduct sperm-cells from a male. We might designate such a female as a "mate" in contrast to a "virgin," but "mate" is in ordinary use for any kind of comrade. Though the words "wife" and "spouse" have too definite a reference to human legal and social status, yet the Latin word "conjux," implying as it does a "conjugium" (the significance of which is given in Virgil's account of wind-fertilised mares, "sine ullis conjugiis vento gravidae"), might well be used as the antithesis of "virgo." Any female bearing hysterogamic egg-cells is accordingly a "conjux," whilst one discharging "planktogamic," or it may be "propylogamic," egg-cells is a "virgin."

The existence of "hysterogamesis" leads on to that phenomenon which was by Aristotle regarded as a highly important "differentia" in the classification of animals, and is loosely described as "viviparity." Animals which pass a large part of their embryonic growth within the mother's body and are born naked and with much of the shape and locomotive capacity of the adult are called "viviparous" But really all animals are viviparous, for the birth-product is a living thing whether it is a naked egg-cell or more or less advanced in development. The enclosure of the birth-product in a shell or case, which has given rise to the term "oviparous," is not of any value as indicating the real degree of development of the young at birth, for in some cases unfertilised egg-cells, in others mere discs of developing embryonic cells (as in birds, etc.), and in yet other cases well-shaped young ranging from the early larva of some invertebrates up to the completely formed miniature of the adult, as in some of the shell-bearing snails, may be enclosed within an eggshell when "laid" by the mother. There is accordingly no great *general* importance to be attached to the distinction between "viviparous" and "oviparous" animals. The eggshell has, of course, its protective value, but the exact phase and nature of the living thing within it must be considered in any comparison of the reproductive processes of different animals.

I may now show how far the considerations and the descriptive terms here suggested apply to certain typical cases of what is usually called parthenogenesis, but is better designated "autoblastesis" or "lipospermia."

(1) The greenflies, or Aphides, are, as are all insects, characteristically hysterogamic. They are propagated by males and mating females (conjuges) in autumn. But the spring and summer broods are females only. They are virgins, and produce true egg-cells which are autoblastic and develop into several succeeding generations of impaternate females (lipospermia or parthenogenesis). The egg-cells of these virgin mothers are modified so as to be incapable of zygosis, whilst the maternal structures connected with hysterogamesis (maternal fecundation) are aborted, although the intra-uterine gestation is retained and the young are born naked in a fully formed condition, whence they are said to be "viviparous."

(2) The phyllopod Crustacean Apus normally gives birth to egg-cells encased each in a delicate eggshell. These are autoblastic, and produce with very rare exceptions only impaternate females. At rare intervals, owing to conditions not ascertained, a few impaternate males are hatched from some of the eggs, and "propylogamic" fertilisation of the eggs of some of the virgin mothers of the same generation then takes place.

(3) The breeding queen bee (Apis) and the breeding queens of some other hymenopterous insects are at the same time both parthenogenetic and gamogenetic! They are definitely "conjuges," or mated females, but some of their eggs are hysterogamic and give rise to females only, whilst others are agamic (lipospermic) and give rise by autoblastesis to impaternate males (drones) only. This remarkable double character of the "queen" is due to the fact that the sperm-cells of the drone received by her into her spermatheca can be withheld from contact with the egg-cells about to be laid or admitted to them according to circumstances. Fertilisation of the egg-cell is (to use a French term) "facultative."

(4) Silkworm moths and some other female Lepidoptera sometimes lay eggs without having mated or come into contact with a male. Not infrequently these eggs, which in normal conditions should be hysterogamic, proceed to develop by autoblastesis, and produce impaternate males and females. This lipospermic reproduction is stated to have been experimentally carried out through three successive generations. The autoblastesis can be favoured, if not determined, by brushing the shell of the egg with a camel's-hair pencil.

(5) The female of the common frog is, like that of nearly all bony fishes, in all circumstances a "virgin." Her eggs are planktogamic. Other Amphibia may be propylogamic or even hysterogamic. When received into carefully purified water, the unfertilised eggs of the common frog, which are naturally enveloped, each in a jelly-like coat, can be caused to enter upon the curriculum of cell-division and embryonic growth by scratching the surface of the dark-brown egg-cell with a needle. The impaternate offspring thus produced have been reared to late stages of the tadpole phase, and more rarely to the adult form. The impaternate or fatherless young thus reared have, so far as at present recorded, always proved on examination to be males.

Other cases of lipospermia or autoblastesis, such as those revealed by the experiments of Loeb, Deslages, and others, could, I think, be with advantage summarised by the use of some such nomenclature as that here suggested. Autoblastesis is contrasted with gamoblastesis, but its occurrence is not "spontaneous." It depends upon either mechanical or various chemical conditions which could be enumerated and classified.

E. Ray Lankester.

The Scandinavian Languages.

In the scheme of examination (see Nature, vol. xcix., p. 475), it is curious to see Norwegian and Danish, which have the same dictionary, separated by the very different Swedish language.

T. R. R. S.

August 14.

THE CIVIL AERIAL TRANSPORT COMMITTEE.

NO time is going to be lost in facing the new problems arising from the war, and in setting to work on them at once at the earliest favourable opportunity.

The title, "Civil Aerial," of the committee shows how the experience of the novel warlike conditions are to be utilised in peaceful application, in a flying post at least of an airplane, and possible extension to the large airship for passenger service across the sea.

Throwing intellectual timidity overboard, we no longer await the sequence of events, watching the progress of the rest of the world to see what is best, and reap the advantage of waiting and at no expense. The economy of this *cunctando* policy has proved illusory.

Unlimited money, poured out in war like water, has solved these problems, and the leisurely hesitation of official timidity has been flung aside on the scrap-heap of unloading initiative and expense of experiment on private enterprise.

Going back in human imagination as far as history can carry us, we always find the obsession of the poet and artist dreamer for human flight.

In Chaldæan, Assyrian, and Babylonian ages we have only the sculptured representations to go by; but Homer, Æschylus, Plato describe the flight of the gods through the air as a matter of course, and blame the engineer inventor, Prometheus, for being so slow to put the idea into action for his fellow-men, Dædalus and Icarus, as Jules Verne has blamed us of his own time by implication.

In the Greek play Old Ocean arrives at the wings as the *deus ex machinâ,* a flying machine, dismounting from his mechanical four-footed bird, an Arimaspian griffin, after a single flight to the Caucasus from the Pillars of Hercules—Gibraltar and Jebel Musa. This is his radius of action, as the bird is said to be anxious to return to the perch in his cage. The daughters of Ocean have already put in an appearance as Chorus on their winged chariot, careful, they tell us, to lighten the load by removing their sandals, and so reluctant to put their bare feet on the ochreous earth of the volcanic mountain-top of the Caucasus.

Such details of scientific interest escape the attention of the classical schoolmaster, absorbed in the grammatical parsing; and he would hate to be told of their existence, for fear the inquiring scientific boy should start asking questions he could not answer himself.

Not only in Chaldæan, Babylonian, Hebrew, Chinese legends, of Ishtar, the prophet Habakkuk, and the Bronze Dragon, but in Greek art also, the mysterious *rôle* of the fabulous griffin can be traced, such as the supporters of the theatre stall in Athens of the priest of Dionysus; also in the bas-relief in St. Mark's, Venice, representation of the legend of Alexander, as told by Callisthenes, flying in his chariot of sixteen-griffin power, but room only for two in the sculpture (reproduced in the photograph); capable of being used also as a submarine. The artist has followed closely the description of Callisthenes in giving Alexander a long stick in each hand to steer the unbridled griffins. A savoury lump of meat is fixed on the end, and the griffins follow this with their eyes and fly after it.

LA LEGGENDA DI ALESSANDRO.

Many similar sculptures could probably be traced in our own cathedrals if only a trained search was made.

So the griffin is the crest to be selected appropriate for the Civil Aerial Transport Committee, and not a winged figure as Icarus, which never would work mechanically except on the small scale of the dragon-fly. *Pennae non homini datae.*

The romantic history of the subject is too vast to be followed up here any further. And the jaunty poetic imagination has never ceased to reproach the engineer descendants of Prometheus for declaring the problem impossible mechanically. To-day they can turn on him with the unanswerable—"I always told you so." But mankind had to wait all these previous æons for the motive power, not the mere power of the imagination,

but of a real machine strong and light enough to raise itself in the air with a man astride. This was the gift ready-made by the motor-car, of the petrol engine and no boiler. Twenty-two years ago a valiant attack was launched by Maxim (Nature, August, 1895), but he was obliged to make his machine big enough to take up a boiler in it, and here he was beaten. If Maxim failed then, it was certain no one else had a chance of success in a flying machine—

He that it wroghte couth ful many a gin.

The committee is well provided with the imaginative element, ready to go one better than Jules Verne and Peter Wilkins; and the historian of it must take in hand an adequate account of artificial flight before it came to birth less than ten years ago. A beginning has been made in "Flugprobleme in Mythus Sage und Dichtung," published by the I.L.A. in 1910, and produced under Government encouragement years before we made a start. But the most important epoch in actual history was July 25, 1909, when Bleriot made the Channel passage, about the time Chavez was unfortunate in meeting his death in the moment of victory of crossing the Simplon in the air.

The imaginative talent of the committee must be supplemented and checked by a Lardner genius, to work out the sober arithmetical details as a guide in the actual design, similar to those required by the Committee on Steam Communication with India, 1830, and entrusted to the original Lardner.

The reckless optimism of a Brunel and Scott Russell must be discounted to its true value by the criticism of sober figures, as in Lardner's report to the Liverpool Chamber of Commerce, 1835, in pointing out the commercial fallacies of wild-cat schemes, and the need for a Government subvention, demanded already for aerial transport to make a start in the commercial aeronautics discussed by Mr. Holt Thomas before the Aeronautical Society, and reported in the *Morning Post* of May 31 last.

However learned he may be in Geometry, the poet and artist has never studied so far as into Mechanical Similitude. The artist paints his angel Michael with graceful wings in full flight, and invites us to imagine his diminutive figure, of dragon-fly scale in the picture, as enlarged to life-size. On the small scale of the picture, flight may be possible with the wing and horse-power available. But when the linear scale is enlarged tenfold the weight mounts up a thousandfold, but only a hundredfold in wing area, and the lift is ten times too small at the same speed, or, say, three times too small if the speed is increased on Froude's law.

In the airship design, for a given diameter of action, say, across the Atlantic, or radius of action, as in a joy ride to the North Pole and back, an immediate application can be made of Froude's law, as in the *Engineer* for May 19, 1916.

The laws of mechanical similitude are not quite so simple for a flying machine heavier than air, but a calculation can be made on the basis that in a given flight the horse-power-hours and petrol will vary inversely as the square of the speed, so that half the petrol will serve if the speed is increased 40 per cent., or that the same supply will carry over a double flight.

No difficulty will be felt of tide or draught of water at the terminal port, and the height of the course can be varied so as to choose the favourable current of air. But we must not anticipate further the labours of the scientific members of the committee, as they will prefer to carry out these calculations unassisted.

An aerial postal service between Italy, Sicily, and Sardinia has already been established, as we read in the *Journal of the Society of Arts*, August 3 (see Nature for August 16, p. 490).

The commercial success of an Atlantic airship service is well within sight. Meanwhile, to begin with, a pleasure trip to the North Pole may be contemplated here, as likely to attract the patronage of the enterprising traveller and give confidence to the public. Advertised to leave Bergen in latitude 60° early on a Saturday morning, the airship, at fifty-knot speed, would be over the North Pole at midday lunch on Sunday, and back again to land the passengers on Monday night.

How does the pilot know when he is over the Pole; and when there, how can he find his way back by compass? These are questions for the new navigation required in aerial transport, still to be written.

An important course, such as that to America or Japan, taken on the great circle, will pass very close to the Pole, so that a slight detour to please the passengers need not add appreciably to the mileage. Here the old method of Lunars will come to the front again, displaced in ordinary low latitude by the superiority of the chronometer.

Nansen lost his way back from the Arctic Circle when his chronometer had run down, although the moon stared him in the face, inviting a lunar distance observation, which he could have taken with accuracy enough by a piece of string and the assistance of the nautical almanac, as described in Lord Kelvin's lectures—a revival of ancient methods of navigation such as were employed by Ulysses.

G. Greenhill.

THE "ISLE OF WIGHT" BEE DISEASE.

The mortality among bees which passes by the name of "Isle of Wight" disease continues with unabated severity, and has now spread to nearly every district in England, destroying innumerable colonies in its progress and threatening to annihilate, or at least reduce to insignificant proportions, the bee-keeping industry in this country. Even in time of peace and unrestricted import, this would be a grave misfortune; at the present time, when sugar in every form is needed for human food and is steadily becoming scarcer, it is a national disaster which for some unaccount-

able reason appears to have escaped the attention of the authorities.

The mortality which has acquired the popular name of "Isle of Wight" disease from the fact that it was first observed about twelve years ago in that island and for some time was practically confined to it, is in reality not so much a disease as a group of diseases, all of which are fatal and produce the same macroscopic symptoms in the affected insect. The condition known as "crawling"—that is, the inability, more or less pronounced, to fly in spite of desperate efforts—the distortion of the wings, the fæcal discharge known as "dysentery," the dwindling of the numbers of the worker bees, and their sudden and apparently unaccountable death in large numbers are considered by the average bee-keeper to justify him in declaring his bees affected with "Isle of Wight" disease, but none of these symptoms are truly diagnostic.

The honey bee, as was pointed out in an article in NATURE of March 2, 1916, has singularly little power of expression, and the writer of the present article has observed the distortion of the wings at one time supposed to be characteristic of the disease in an apparently healthy bee killed in an entomologist's "killing bottle." Some, if not all, of the symptoms referred to may be present whenever bees die of a virulent disease, while there are at least three natural agencies, and possibly more, which cause the "sudden death of bees in large numbers," which Zander[1] says is the most obvious way by which bee disease can be determined. These agencies are (*a*) *Nosema apis*, (*b*) amœboid parasites, and (*c*) certain yeasts present in fermenting pollen.

The first of these alone causes microsporidiosis, the true infectious "Isle of Wight" disease, but the outcome of the confusion of all these maladies under one name has been a vast amount of loose talk and unscientific remedies, to use no harsher term. A preparation of coal tar, a combination of several germicides, hydrogen peroxide, sulphate of quinine, and even pea-flour have all been put forward as sovereign remedies and extensively sold to distracted beekeepers. Confident claims that this or that race of bees is immune to the disease have been put forward from time to time, and well-meaning but wholly unscientific attempts have been made to resuscitate the waning industry in places where the mortality has been highest by the introduction of new stocks either of alleged resistant strains or of healthy, but of course susceptible, colonies from some district supposed to be free from infection. The result has generally been disastrous, and there are now many parts of England, where formerly there were hundreds of colonies, in which the industry of bee-keeping has been almost abandoned in despair and a honey bee is a rare insect.

What then is the remedy? Without conceding all the claims that bee-keepers have made as to the value of their charges in fertilising the blossom of fruit trees—for it must be admitted that in the absence of honey bees the work of pollination is performed by other insects—it is allowed that bee-keeping is an important national industry. The nectar in flowers, if not collected and turned into honey by bees, is lost to the service of man, and now more than ever it is desirable to accumulate and utilise every kind of food that can be produced at home.

At the same time, the individual bee-keeper is helpless. Even in the rare cases where he is a man of science, he has no means of effecting a cure if his bees are attacked; still less has he the means of preventing infection. The control, and where possible the eradication, of contagious disease is a matter for Government intervention, but the Bee Diseases Bill which was twice introduced into Parliament by the Board of Agriculture was abandoned owing to the active opposition of a certain section of the bee-keeping community. The Government can scarcely be blamed for relaxing its efforts to control the disease in view of the lukewarm support it has received from the persons who would have benefited had those efforts been successful. The only hope appears to be in the universities, the National Agricultural and Horticultural Societies, or in the last resort the wealthy benefactors, who might conjointly form a National Bee-keeping Institute for the improvement and development of the industry, the study of disease, and the improvement of the breeds of bees kept in the British Isles.

The lines on which further research should be conducted are more or less indicated by the results already achieved. The organism that causes microsporidiosis is known, its life-history is fairly well understood, and the conditions under which Nosema flourishes and the principal means of infection have been ascertained. What is now desired is a suitable treatment and a study of the conditions under which recovery can best be secured. It is, of course, unwise to reason too closely from analogous diseases in other animals, but it is at least possible that the investigations that are being made into amœbic dysentery in man may give some clue to the discovery of a method of dislodging the parasite from its home in the cells of the bee's stomach, or of paralysing the activities of the "planont" before they are able to effect their lodging there. At the present time scientific research in bee-keeping is almost at a standstill, and a new departure is needed. Is it too much to hope that some of those who have devoted themselves to the study of epidemic diseases in man should apply their experience in the service of a humble but useful form of husbandry?

[1] "Handbuch der Bienenkunde," vol. ii.

NOTES.

WE learn from *Science* that Dr. R. A. Millikan is acting as the representative of the U.S. National Research Council in general charge of scientific questions referred to the council, that Dr. C. E. Mendenhall is in charge of the development of the various instruments used in connection with aeroplanes, and that Dr. A. Trowbridge has organised an important branch of scientific service for the U.S. Army in

France. The Carnegie Corporation of New York has voted an appropriation of 10,000*l*., or so much of that sum as may be necessary, to the Carnegie Institution of Washington to meet expenses incurred by the National Research Council during the war.

THE following committee to deal with problems either psychological, or having a psychological aspect, in connection with the war has been organised by the U.S. National Research Council: Messrs. J. McKeen Cattell, G. S. Hall, E. L. Thorndike, R. Dodge, S. I. Franz, G. M. Whipple, C. E. Seashore, J. B. Watson, and R. M. Yerkes.

ACCORDING to *Engineering* a Chemical Industries Bureau is in course of formation in Sweden, the object of which will be to bring together the Swedish chemical industrial interests, to keep in touch with changes and developments within its domain, and to further the special requirements of the chemical industry in its various branches.

THE fifth annual meeting of the Indian Science Congress will be held in Lahore on January 9 to 12 next, under the presidency of Dr. G. T. Walker, F.R.S., Director-General of Observatories. The sectional presidents will be:- Dr. L. Coleman (Agriculture), Dr. Wali Mahomed (Physics and Mathematics), Dr. G. J. Fowler (Chemistry), Dr. Choudhuri (Zoology and Ethnology), Mr. R. S. Hole (Botany), Mr. E. S. Pinfold (Geology). Dr J. L. Simonsen, of the Presidency College, Madras is the honorary secretary for the meeting.

SIR JOHN STIRLING-MAXWELL has undertaken the duties of Assistant Controller of Timber Supplies for Scotland.

WE regret to have to record the death, on August 18, of Prof. S. B. Kelleher, Erasmus Smith professor of mathematics in the University of Dublin.

THE death is announced, on July 27, of Dr. W. B. Clarke, professor of geology in the Johns Hopkins University, director of the Maryland State Weather Service, and State geologist for Maryland.

THE Charles P. Daly medal for geographical research has been awarded by the American Geographical Society to Mr. G. G. Chisholm, lecturer in geography in the University of Edinburgh. The inscription on the medal reads:- "To George Goudie Chisholm, scholar, teacher, author. Through sustained research and broad generalisation he has created a world-wide interest in the geographical basis of commerce."

THE David Livingstone centenary medal of the American Geographical Society has been awarded to Señor M. V. Ballivian, president of the Geographical Society of La Paz, Bolivia. The previous recipients of the medal are Sir Douglas Mawson and Col. Roosevelt.

A CATALOGUE of current journals dealing with chemistry and chemical industry, and the libraries in which they can be consulted in the United Kingdom, is being prepared by the Society of Chemical Industry. The journal list comprises about 5000 titles, and contains journals from well-nigh every country, almost all of which periodicals were, it is believed, current at the beginning of the war. Chemistry and chemical industry are treated in a very broad spirit, the list including journals dealing with all industries in which chemistry enters. Some 800 libraries will be listed, so that from the completed catalogue it is hoped that any chemist will be able to find the most convenient library in which he can consult any particular journal. The completion of the catalogue during the ensuing winter is aimed at.

THE Petroleum (Production) Bill introduced by Mr. Long in the House of Commons on August 15 may have proved a surprise to many, who probably had not realised that the discovery of petroleum in this country is possible; indeed, various favourable indications have long been evident. In no industry has there been such prodigious waste; there has been the rush of pioneers boring throughout a district where oil has been proved; there has been the frequent gush of oil which could not be dealt with, leading to losses of millions of gallons. With the possibility of the industry being established in this country we should profit by past experience gained in the rich oil-producing countries, and this Bill is to be heartily welcomed as an important step, providing as it does for investing in the Government all rights to get petroleum, and arranging for leases and defining petroliferous areas, payment of fixed royalties, and the general control through the Board of Trade. The Government thought it right, in view of possible adventurous schemes, to put the matter forward at once in order that unfortunate enterprises might be checked. Whilst private enterprise might undertake the exploratory borings, this is surely such a speculative business, and yet of such vast importance if expectations are realised, that it would appear desirable that the preliminary work at least should be liberally assisted, or entirely borne, by the National Exchequer.

DURING excavations at Horncastle a short time ago a human skeleton was discovered. The bones were in a very good state of preservation, and indicated that the body had been buried on its back, at full length. By its side were a long sword, a large spear, and a smaller one, all of iron. These have just been purchased for the Municipal Museum at Hull. The remains are of Anglo-Saxon date, and were probably brought to this country by the Angles, and as these people came largely from Angle-land, in the district now known as Sleswick, the relics may be said to relate to an early Teutonic invasion of Lincolnshire. The sword is remarkable for its length, is double-edged, and, though naturally slightly corroded, is in a very fair state of preservation. Its total length is 33 in., it is $1\frac{3}{4}$ in. in width, and it tapers at the top in order to accommodate the handle. Quite apart from the archæological value of this collection, the sword is of particular value, as these weapons are very rarely found in Anglo-Saxon burials, though spears and other weapons are not uncommon. In his work on "The Industrial Arts of the Anglo-Saxons" Baron De Baye points out that the scarcity of swords is due to the fact that only individuals belonging to the upper classes were buried with this weapon, and that no doubt the swords were preserved as family treasures and left to heirs or friends.

IN the *Museum Journal* of the University of Pennsylvania (vol. vii., No. 4, December, 1916) is a reprint of an ancient Babylonian map showing part of the agricultural area of the city of Nippur, prepared about 1500 B.C. It throws a welcome light on an obscure provision in the celebrated law code of King Hammurabi. The map describes the custom of blowing a horn at the village gates to notify to the shepherds of the plains that the grazing season was over. Thus rural villages in which the people congregated for mutual defence appear to have been so arranged that the village buglers were able to make the shepherds and farmers hear the sound of the horn throughout the whole land of Babylonia.

IN the *Scientific Monthly* for July (vol. v., No. 1) Prof. Leo Rettger discusses some of the newer conceptions of milk in its relation to health. He emphasises the nutritional value of milk as milk, irrespective of

whether it is whole, skim, sweet, or sour milk. Many persons have little or no tolerance for sweet milk, while sour milk, or buttermilk, is well borne. On account of the highly important known food substances which are present, namely, fat, sugar, casein, lactalbumin, and certain inorganic salts, and of the as yet poorly understood vitamines, or accessories, milk has a most stimulating influence on bodily growth and strength, and is therefore an important factor in regulating and preserving health.

THERE is considerable need for an "ink" for the skin for localisation marks. It should stain the skin such a colour that it will show up against iodine, be unaffected when rubbed with alcohol, ether, acetone, etc., last for some days under a dressing, and not damage or inflame the skin. Capt. Finzi gives the following formula, which fulfils all these requirements:—Acid. pyrogallic., 1 gram; acetone, 10 c.c.; liquor ferri perchlor. fort., 2 c.c.; sp. vini meth., ad 20 c.c. The mixture keeps well, and can be applied with a brush. The mark is brownish-grey at first, but after a few hours becomes a brilliant black (*Archives of Radiology and Electrotherapy*, No. 204, July, p. 38).

WE have received a copy of the report on explorations and field work of the Smithsonian Institution for 1916 (*Smithsonian Miscellaneous Collections*, vol. lxvi., No. 17). The volume contains short reports from about thirty investigators in geology, zoology, botany, archæology, ethnology, and astrophysics in various parts of the world, from the United States, Cuba, and Venezuela to South Africa and Borneo. The result of these investigations is to enrich the National Museum with material for exhibition and research. The outbreak of war practically cut off all the supply of animals for the National Zoological Park, as the trade was formerly almost wholly in German hands. The New York, Philadelphia, and National Zoological Parks sent a representative to South Africa, aided by a grant from the Smithsonian Institution, and he was successful in securing a certain number of ruminants, birds, and reptiles, chiefly from the Zoological Gardens at Pretoria. It should be noted that some of the excellent photographs in this volume are of permanent scientific value, although it claims to be only a summary of work done.

A VERY concise and admirable summary of the "Moults and Sequences of Plumages of the British Waders," by Miss Annie Jackson, appears in *British Birds* for August. This is apparently meant to serve as an introduction to a detailed description of the plumages of the several species on the British list, which will prove a very useful piece of work, since it will not only summarise what has already been written on this theme, but also include much original work by Miss Jackson. Only during recent years has this subject been seriously investigated, the earlier collectors caring for little but adult males in their nuptial dress. Hence it is that none of the great collections of skins examined in the course of the preparation of this paper contain skins of the oyster-catcher, stone-curlew, greenshank, or red-necked phalarope, showing the transition from the first winter to the first summer plumage. But these are only a few of many gaps in our knowledge of this matter which have yet to be filled.

IN a lecture published in the May issue of the Journal of the Royal Statistical Society Lord Dunraven advocates the nationalisation of the marine and fresh-water fisheries. He suggests that the State should take over these industries in the same way as it now controls or works others of national importance. Such Government acquisition, control, and development would, he expects, result in the cheapening of fish as food, and also in a very great increase of revenue, since the State would acquire the original and intermediate profits. The lines of development are suggested. Methods of preservation of fish by cold storage, salt curing, canning, and analogous processes should be applied on a large scale, and means of distribution of fresh fish should be greatly extended. Methods of "scientific fertilisation of fish-culture" should be practised on a very much broader basis than has hitherto been attempted. In this way the author hopes to see the fresh-water fisheries developed and salmon cheapened again to its original price of 4d. per lb. He advocates the removal of restrictions on methods of fishing and the re-opening of many days formerly closed to trawling, and generally urges the adoption of many of the recommendations of the Inshore Fisheries Committee of 1913.

M. JOHS. SCHMIDT contributes an interesting article on the occurrence of the wild hop in Denmark to the *Comptes Rendus des travaux du Laboratoire de Carlsberg* (1917, vol. ii., part 6). By the distribution of inquiry forms throughout the country a considerable mass of information was collected, especially from forest officials. This shows that the wild hop is commonest in Funen and most rare in West Jutland, but is not found on several small islands. The wild hop propagates by seeding as well as by the vegetative process. The seedlings grow slowly, do not flower the first year, and probably but rarely in the second. The flowering time at one locality in North Zealand was found to occur (1911–15) at the end of July or the beginning of August, the male plants commencing to flower somewhat earlier than the female. The hop has not hitherto been found in prehistoric deposits in Denmark, and it is therefore uncertain whether it existed there prior to human habitation. Generally the wild hop is of small value for brewing purposes, as it contains but little bitter resins. Some plants, however, were obtained which contained as much as 14 per cent. of this constituent. The same author has found that although the quality of "aroma" is absent from the male plant, it can nevertheless be transmitted to the offspring through the male parent. When an American male plant was crossed with a European female plant the offspring plants gave hops which exhibited typical "American" aroma.

WE have just received three recent parts of *Bergens Museums Aarbok*, published in 1915 and 1916. One of the most important articles is that by Prof. Nathorst on some plant remains found in the Hornelen district, at the mouth of Nordfjord. Since these contain *Thursophyton Milleri* they appear to be contemporaneous with the Middle Old Red Sandstone. The generic name Thursophyton is new. There are also new genera: Bröggeria, of very doubtful affinity, and Hyenia, a probable precursor of Sphenophyllum. Both as an introduction to this paper and as a separate article Dr. C. F. Kolderup describes the geology of the west coast district in which the plant-bearing sandstones occur. He also reports on earthquakes in Norway in 1913 and 1914. Zoological articles comprise a preliminary note on the pelagic Nemertines of the German South Polar Expedition, 1901–3, by Mr. August Brinkmann, and a report on the Alcyonarian and Madreporarian corals collected by the *Fram* and the *Michael Sars*, and now in Bergen Museum, by the late Prof. Jungersen. Mr. N. J. Føyn contributes a second report on the climate of Bergen. Volumetric analyses made in the neighbouring seas are communi-

cated by Th. Hesselberg and H. U. Sverdrup, and T. Gaarder writes on oxygen in the fjords of Vestland.

It is not generally recognised that the common British ragwort (*Senecio Jacobaea*, L.) is poisonous to cattle. Such would appear to be probable, however, from cases which have recently been investigated in the veterinary laboratory of the Board of Agriculture, and form the subject of a note in the *Journal* of the Board for July. Under natural conditions the poisoning is a slow process, but with continuous doses the amount of poison which becomes available is sufficient in time to cause very serious symptoms, which often end in death. In one case quoted visible symptoms of poisoning were not observed until forty-four days after feeding on ragwort commenced. No cure has yet been devised, and prevention resolves itself into removing the ragwort from the forage or eradicating it from the pastures. The winter and early spring grazing of infested land with sheep has been recommended for this purpose, and has been practised apparently without harmful results. It would be unsafe, however, to conclude from this that sheep are immune to poisoning by ragwort, since there is reason to think that the flowering season—June to August—is the time of greatest danger. This aspect of the matter is receiving further attention.

The Journal of the Royal Agricultural Society of England for 1916 (vol. lxxvii.) presents the usual features of special articles, notes, and official reports, although for obvious reasons the number of special articles is somewhat curtailed in comparison with past volumes. Dr. Russell and Mr. E. H. Richards contribute an article on making and storing farmyard manure, which outlines various results of interest both for practice and for science obtained in recent investigations at Rothamsted. Attention is again directed to palm kernel cake and meal by Prof. C. Crowther, in a summary of existing information as to the nature, use, and merits of these materials as food for stock. An interesting article on the origin and characteristics of Welsh black cattle is contributed by Prof. C. Bryner Jones. The annual reports of the scientific advisory officers of the society contain, as usual, many matters of interest, of which we may note Sir John McFadyean's account of results obtained at the Royal Veterinary College in the investigation of Johne's disease, and Mr. Cecil Warburton's summary of the present state of knowledge concerning the ox warble-fly.

Various matters of immediate interest to agriculturists are dealt with in Occasional Notes, No. 2 (July, 1917), issued by the Royal Agricultural Society. The general scope and arrangement of the opening number of this new series are retained, the various advisory officers of the society contributing the different sections into which the notes are classified. The notes are essentially practical, dealing, amongst other matters, with the growing of wheat, the raising of farm seeds, plant pests, motor tractors, and calf-rearing.

In the *Rendiconti del R. Istituto Lombardo*, vol. l. (2) 6, Prof. Torquato Taramelli discusses the origin of the deposits of sand found in the island of Sansego and other islands off the Istrian coast, and finds geological arguments in favour of Italy's claims to territory which is the scene of the present military operations. Among the numerous papers previously dealing with the geological features of the islands of the Quarnero basin many references occur to deposits of sand and red earth, but Prof. Taramelli occupies himself mainly with the mass of sand overlying a calcareous base, which forms the island of Sansego. This island has a surface area of about three square kilometres and a circumference of about seven kilometres, and is the outermost island of the Quarnero archipelago. In its composition this sand is largely identical with that deposited by the river Po off the Italian coast, while nothing similar is to be found in the neighbouring Austrian mainland. It is thus inferred that in the Quaternary period the northern portions of the Adriatic were occupied by a vast river basin of Italian origin, and that the natural frontier of Italy, based on geological considerations, extends up to the confines of this basin.

Dr. L. F. Navarro contributes to the *Revue générale des Sciences*, 1917, p. 263, a most useful and interesting summary of what is known as to glacial phenomena in the Iberian peninsula. He points out that well-founded evidence of glaciation in this area, outside the Pyrenees and certain high chains, was brought forward for the first time by W. Halbfass so recently as 1912. The references to literature, including the author's own work, show how rapidly observation is progressing. No general mantle of ice has been traced, even in the Cordilleras; but a sheet of some magnitude, here called "*un grand inlandsis,*" occurred in Leon. Two glacial episodes are recognised, corresponding to the Riss and Würm ages elsewhere in Europe. The author regards these as times when the present conditions in the peninsula were exaggerated in the direction of greater humidity and greater cold. Glacialists, however, are coming to the conclusion that no great demands need be made upon humidity, provided that there is a sufficiently low temperature.

The revolution—a milder word would be inadequate —in the position of the British optical industry is one of the commonplace changes brought about by the war, and it is not surprising to find that the new conditions are reflected in the growth of the Optical Society, which is now thoroughly representative of the industry and is rapidly becoming as fully representative of those whose interest in optics has been of a more theoretical character. Advantage has very appropriately been taken of the improved outlook to issue the society's Transactions at more frequent intervals and in a new form. The first number of the new series, of the same size as the Proceedings of the Royal Society, is chiefly occupied with a paper by Mr. J. W. French dealing with the grinding and polishing of glass. It is suggested that the processes involved are essentially different from those which apply in the polishing of metals. Evidence is brought forward to show that, in the process of grinding, glass is removed in consequence of the formation of conchoidal fractures originating at the points of contact of the glass and the abrasive, rather than by a ploughing action. Incidentally, an interesting method of grading partially worked surfaces is described. The first part of the polishing process consists in ploughing up the soft surface layer of the glass, which has a thickness of about eight wave-lengths, by coagulated lumps of the wetted polishing medium until all the material above the bottom of the deepest grooves has been removed. In the second part of the process, which begins when the water is allowed to dry up, the surface layer of the glass is liquefied by the pressure of the pitch tool and caused to flow until the surface becomes uniform. The paper is illustrated by a large number of excellent photomicrographs, and followed by a discussion in which alternative theories are suggested, and the views of some experienced glass-workers are given. The number is attractively printed, and gives an excellent start to a journal which should play a large part in establishing the optical industry

of this country on a secure foundation, a task in which the Optical Society, where manufacturers and scientific workers are brought into intimate contact with one another, is eminently fitted to lead.

THE most recent contribution of the Bureau of Standards to the problem of the photometry of sources of light of different colours is Scientific Paper No. 299, by Messrs. Crittenden and Richtmyer, who have arrived at a number of general conclusions by collating the measurements made by more than a hundred observers. When two light sources of different colours, such as a carbon and a tungsten filament lamp, are compared by a photometer depending on a setting for equality of brightness, a considerable amount of practice is necessary before consistent results are obtained by any observer not specially trained. When a flicker photometer is used an observer of fair ability can readily get good results, but they differ from those given by the former method. The flicker photometer may give, *e.g.*, the candle-power of a tungsten lamp 3 per cent. less as compared with a carbon lamp than does an ordinary photometer. If the colour sensation of the observer differs from the normal, his comparison differs in consequence, but the authors find that the Ives-Kingsbury method of standardising the eye by the use of glass cells containing aqueous solutions of potassium bichromate 72 grams, and copper sulphate crystals 53 grams, to the litre respectively, interposed between the photometer and two equal sources of light, enables such an observer to get results identical with those obtained with a normal eye.

THE extent to which viscometers of various forms are now used for the classification and identification of oils and other liquids has led the Bureau of Standards to take up the question of a supply of standard liquids of known viscosities for the standardisation of viscometers. The investigation of the most suitable liquids has been carried out by Messrs. E. C. Bingham and R. F. Jackson, of the Bureau, who conclude that mixtures of 20, 40, and 60 per cent. by weight of ethyl alcohol in water, and solutions of sucrose in water containing 20, 40, or 60 per cent. by weight of sucrose, form the most suitable standard liquids. They give the viscosities and fluidities of these liquids at temperatures from 0° C. to 100° C. at intervals of 10° C. in a series of tables, and the variations of the fluidities with change of concentration and temperature are shown by a series of curves. The simple shapes of these curves suggest that it would be better to use the fluidity rather than its reciprocal the viscosity, in all calculations on the subject.

THE Tasmanian Government's Great Lake hydro-electric power undertaking, inaugurated in 1909 and opened last year, is described in the issue of the *Engineer* for July 27. It is based chiefly on a joint utilisation of two rivers—the Ouse and the Shannon—the latter having its source in the Great Lake and the former in what are known as the Ninety-nine Lagoons. The Great Lake lies at a level of 3250 ft. above the sea, and the lagoons are some 200 ft. higher. A curious feature of the two rivers is the great dissimilarity of their gradients, in spite of the fact that their sources are but a few miles apart, and their junction merely twenty miles or so downstream. At one point, about five miles south of the Great Lake, the Ouse is actually 1300 ft. below the Shannon. A dam has been built across the south end of the lake, giving an additional depth of 11 ft., and increasing the storage area from forty-two to fifty square miles. The catchment basin lies in the centre of the island, and is some 227 square miles in extent, and the annual precipitation of rain and snow is upwards of 60 in. By means of a diversion weir the water from the Shannon is turned into a canal, which serves a storage reservoir of 380 acres. The power station is on the banks of the Ouse, and this river receives the exhaust water. The difference in level from reservoir to power station gives a net head of 1015 ft. of water, sufficient to develop a normal output of 4000 brake-horse-power in each of two turbines already installed. The installation has, in fact, proved so successful that an extension is now in hand. Although at present only serving the town of Hobart, the central position of the station renders it convenient for the transmission of power to any point in the island.

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, W.1, have issued a useful catalogue (No. 349) of rare and valuable books, comprising, among others, works dealing with Africa, America, Australia, entomology, ornithology, and physical and natural science. The same firm has purchased the existing stock of "Biologia Centrali-Americana," and has in preparation a detailed prospectus of the work.

OUR ASTRONOMICAL COLUMN.

THE COMMENCEMENT OF THE ASTRONOMICAL DAY.—In a letter to the *Observatory* for August the Astronomer Royal and Prof. H. H. Turner invite expressions of opinion from astronomers as to the desirability of adopting the civil day—*i.e.* the day commencing at midnight—in astronomical ephemerides; and, if thought desirable, as to the most suitable date for introducing the change. It has usually been considered convenient that observations made during the same night should all be of the same date, but this does not seem to them to balance the objection of having a time at variance with the civil reckoning. It is pointed out that the arrangement which is convenient for observations of stars is inconvenient for observations of the sun, and that the change would probably be welcomed by navigators. The only serious difficulty seems to be the discontinuity which would thus be introduced into astronomical records. A change of this kind could only come into operation after some time, as the national ephemerides are prepared several years in advance.

OBSERVATIONS OF MIRA CETI.—In *Ast. Nach.*, 4892, Prof. Nijland gives particulars of seventy-nine observations of Mira made at Utrecht between July 20, 1916, and February 15, 1917. The most probable date of minimum was July 24, when the star was of magnitude 9·4. The maximum occurred on November 8 (J. D. 2421176), the magnitude then being 3·75. The following is a summary of recent maxima observed by Prof. Nijland, together with a comparison with Guthnick's ephemeris:—

Maximum	Guthnick	Obs.-G.	Mag.	Period
J. D. 2420199	0200	−1*d*	3·35	
0527	0539	−12	3·8	328*d*
0852	0870	−18	3·5	325
1176	1201	−25	3·75	324

ECLIPSING VARIABLES.—A further important contribution to the study of eclipsing variables has been made by Prof. H. N. Russell in collaboration with Mary Fowler and Martha C. Borton (*Astrophysical Journal*, vol. xlv., p. 306). The observational data were provided by the Harvard Observatory in the form of 2101 observations of the photographic brightness of the six eclipsing variables, W Delphini, U Sagittæ, S Cancri, RW Tauri, SW Cygni, and W Ursæ Majoris. The resulting light-

curves for these stars were compared with those derived from visual observations, and it was found that identical geometrical elements gave a satisfactory representation of both the visual and photographic curves. Light-curves with the same epoch of mid-eclipse, however, do not satisfy both sets of observations, the difference amounting to as much as twelve minutes in the case of S. Cancri. The differences in velocity of the visual and photographic rays which would be required to explain the discrepancies in the case of the six stars in question range from −0·9 to +5·1 metres per sec., and are so discordant as to furnish no evidence in favour of an explanation based upon differences in velocity of light of different colours. On the contrary, the observations prove the identity of the velocity of light of the different wave-lengths within a few metres per second. The discussion strengthens the view that the typical eclipsing binary of large range consists of a small, bright, dense component of Class A, or thereabouts, and a large, faint component of much lower density, of Class G, or redder. It is considered highly probable that the component of low density represents the earlier stage of evolution. In addition to the already astonishing amount of information which has been derived from the study of eclipsing variables, it is expected that from them it will be possible to determine the relation of colour-index to surface brightness, and thence the linear diameters of all stars of known colour-index and parallax, and the angular diameters of all stars of known spectral type.

DRUM-FIRE.

THE following is an abbreviation of a letter by Mr. G. F. Sleggs which appeared in the *Times* of Tuesday last. The conclusions arrived at are the result of eighteen months' experience at the Front:—

There is a fundamental and peculiar difference between the sound emitted by a gun and that of an exploding shell. When the gun is fired the sound-wave produced is of a totally different nature from that produced by the burst of a shell. In the former case the impact of the gases leaving the muzzle, as it were, "strikes" the atmosphere in the direction in which the gun is pointed, but the burst from the shell causes a sound-wave of uniform intensity all around, as the gases emanating from the high explosive are not confined in any direction, as is the case with the cordite of the gun, the only escape being at the muzzle. Every soldier who has been to the Front knows that if you stand in front of a field gun or naval gun whilst firing even at a considerable distance (several hundred yards), the crack is painfully intense to the ears, and may even cause injury, whereas it is possible to stand close behind the gun with comparative impunity. In other words, the sound-wave from a gun is more concentrated along its line of fire than elsewhere. No such difference is observable with a shell, its concussion being equally violent to the ear whether it explodes in front of or behind one.

The laws of sound say that the intensity of the sound emitted from a body grows less in proportion to the square of the distance of the ear from the source of the sound; in other words, at double the distance the sound is a quarter as great. This, of course, is identical with the laws of light, and applies perfectly to the shell, but not to the gun, in the same way as the ordinary law of the intensity of light will apply to a candle, but not to a searchlight, which concentrates its light along one path instead of distributing it equally all around. Hence we are driven to the conclusion that the wave of sound emitted by a gun is closely analogous to the wave of light emitted by a searchlight. The intensity of the ray from a searchlight only diminishes gradually, and this analogy is borne out by the peculiar fact, familiar to those who have been in the trenches, that the German machine-guns, or rifle shots, always seem as loud whether the width of "No Man's Land" is seventy yards or 500 yards. One of the most wonderful and, indeed, majestic of all sound phenomena in connection with artillery is the great "roll" that follows the discharge of a high-velocity gun. To hear this at its best one must visit a part of the front where the contour is rugged, or where the landscape is well wooded, and where houses and other excrescences are abundant, as at Arras. The report of the cannon is followed at once and continuously by a majestic echoing roll that may be compared to a mixture of thunder and the music of a mighty bass orchestra. This rolling sound seems to travel forward as though it were following the flight of the shell, and is, indeed, mistaken by some for the actual sound of the shell.

The real explanation, however, is that it is a series of echoes from the thousands of heterogeneous excrescences in the surface of the landscape, each of which sends back its echo to the ear, the whole combining to form a continuous trail of sound. Now the fact that this continuous sound travels in the direction of the shell, and hence in the line of fire of the gun, also fits in with the searchlight analogy; as otherwise if the sound of the firing gun were not concentrated along its line of fire this chain of echoes would not appear to flow in any definite direction, and thus one of the most grandiose aural phenomena that the ear can receive would not exist.

The above considerations give rise to a remarkable and surprising fact, which, indeed, arises in theory and is borne out in practice. This is, that at a certain distance and upwards from the firing-line the sound of the German guns will be greater than the sound of our own, because we are in front of the German guns but behind the British, and although the latter are nearer to us, yet the sound of the former will appear louder and sharper because of the peculiar nature of the sound-wave emitted from the muzzle of a gun, the noise being nearly all concentrated in the direction of fire. Thus, when approaching the firing-line before a big attack, the sound of the German guns often appears to preponderate over our own, giving one the apprehensive impression that the enemy's artillery is in superior strength to our own, and it is only in coming into the artillery zone that the British superiority is perceived. Another point illustrating this is the origin of the word "drum-fire." This term (*trommel-feuer*) was first used by the Germans to describe the effect of our massed artillery on an unprecedented scale on the Somme. Now to the British, who were, of course, behind the direction in which their artillery was firing, this term would never have occurred, for to be behind a British bombardment there is but little resemblance to a drummer's tattoo, the whole sound being merged into a dull and heavy roar of guns; but to the German generals behind their lines every shot from the British guns would stand out as a sharp staccato note, the whole combining to give the impression of the rat-a-tattat of a mighty drum tattoo.

From these conclusions it will appear that the further one is behind the firing-line the greater is the tendency for the sound of the German guns to preponderate over our own, although the latter may be in much greater strength, and the probability is that the greater part of the noise of firing audible on our coasts comes from the German artillery and not the British, although the sound of shell bursts may tend to modify matters.

THE TREATMENT OF WAR WOUNDS.[1]

WE are wont to classify the patients in our military hospitals into sick and wounded. In reality all, or nearly all, are suffering from bacterial infections. And the essential difference between the sick and the wounded lies in this, that the sick are suffering from infections spontaneously contracted, the wounded from infections induced by mechanical injuries. My theme is the treatment of this latter class of infections. They are distinguished by certain quite special features.

In spontaneous infection we have to deal with microbes which have fought their way into the body, and generally only a single species of microbe will have done this. In wounds we have microbes mechanically driven in, and every sort of microbe which exists in external Nature may thus be introduced.

But let me, before embarking upon the question of their treatment, first tell you something about the

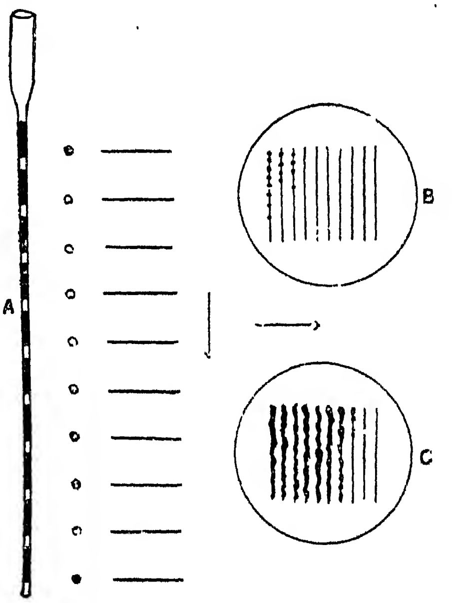

FIG. 1.—Method of pyo-sero-culture. A, Pipette which has been implanted by the wet-wall method, and has then been filled in by the wash and after-wash procedure with unit-volumes of serum. By the side of the pipette to the right is ranged a series of drops representing the series of unit-volumes of serum blown out in order from the pipette, and, finally, to the right of the drops is a series of lines representing linear implantations made upon agar. B, Results of the series of linear implantations made with the unit-volumes of the patient's serum. C, Results of the series of linear implantations made with the unit volumes of the normal serum which was used as a control.

natural agencies by which the inroads of microbes are combated. You are, of course, aware that we are guarded against microbic infection by our blood fluids and our white blood corpuscles.

THE BODY FLUIDS.

Let me begin with the blood fluids, and let me take you directly to the following experiment. I call it the experiment of *pyo-sero-culture—i.e.* the experiment in which we implant pus into serum to see which of the microbes of the wound can grow in the blood fluids.

We procure for our experiment a suppurating wound. We take from it a specimen of pus containing a large variety of different organisms. At the same time we take from the patient's finger a sample of blood; and we take a specimen also of our own. When the serum has issued from the clot we take a capillary pipette, fit a rubber teat to the barrel, and inscribe a mark upon the stem at about, say, one-third of an inch from the tip. We now aspirate a little pus into the stem, drawing it up only so far as our fiducial mark, and, blowing it out again, leave a wash of pus upon the walls. This done, we sterilise the tip of the pipette, and then aspirate into the stem a series of unit-volumes of serum, dividing each volume off from the next by a bubble of air. The pipette when filled in this manner presents the appearance shown in Fig. 1, and we have in the proximal end our first and heaviest implantation of pus, and in the distal end our last and lightest implantation. The pipette is now placed in the incubator to allow every microbe which is capable of growing in serum to do so. After an interval of six or more hours we proceed to our examination. What we do is to blow out our series of unit-volumes of serum in separate drops and examine under the microscope; or, better, we plant out a sample of each drop upon a separate seed-bed. Here in B and C you have the results of such culture represented diagrammatically the meagre crop in B being that obtained with the patient's serum, and the more copious crop in C being that obtained with normal serum.

And you have in the next figure (Fig. 2) a drawing of an agar tube implanted from a pyo-sero-culture made with the serum of a wounded man. In the upper part of the agar tube you see two seed-plots implanted from the distal portion of the capillary stem. These have remained sterile. In the middle of the tube you see four plots implanted from the unit-volumes of serum which occupied the middle region of the capillary stem. These have grown colonies of only one species of microbe the streptococcus. At the bottom of the tube you see seed-plots implanted from the proximal end of the capillary stem. These are overgrown with colonies of staphylococcus. But no doubt interspersed with, and overgrown by, these are also colonies of streptococci. If, instead of cultures from the patient's serum, I had been showing you here cultures from normal serum, what you would have seen would have been a much larger number of fertile seed-plots, and the seed-plots implanted from the proximal end of the pipette would have shown a large assortment of different colonies.

FIG. 2.—A portion of a pyo-sero-culture planted out upon an agar slant divided up by furrows into a series of seed-beds.

We learn from such experiments three lessons: *first*, that in the uncorrupted serum in the distal region of the pipette only two species of microbes from the wound can grow and multiply; *secondly*, that in the corrupted serum in the proximal end of the pipette all the microbes of the wound can grow; and, *thirdly*, we learn from a comparison of the wounded man's serum with the normal serum that the former offers more resistance to microbic growth, and is less easily corrupted by the addition of pus.

Cause of the Corruption of the Serum.

Experiments of this kind clearly do not tell us the cause of the corruption of the serum. That corruption

[1] By Sir Almroth E. Wright, C.B., F.R.S. In its original form this lecture was delivered at the Royal Institution on March 9. It was supplemented by additional matter relating to antiseptics and the method of Carrel, and was printed in full in the *Lancet* of June 23. Parts of the lecture of purely technical interest have been omitted.

may be due to some chemical substance contributed by the pus to the serum or to something special in the character of the bacteria implanted. This point we can clear up as follows. We go back to our very septic wound. We clean it out carefully by syringing. That leaves us with a wound cavity clean but still abundantly infected. We then take the little cupping apparatus which is shown in Fig. 3. We apply it to the walls of the wound, using light pressure. Then, puncturing the attached rubber tube with the needle of a hypodermic syringe, we withdraw the contained air, and leave our lymph leech *in situ* adhering by negative pressure until the time for redressing the wound comes round. When we now go back to our wound we find there two quite different discharges. We have in the general cavity of the wound a thick pus containing many broken-down leucocytes and pullulating with all sorts of microbes. In the body of the lymph leech we have a nearly clear lymph containing well-preserved leucocytes and only a very few staphylococci and streptococci. Since we had on every part of the walls precisely the same amount and kind of bacterial infection, and since we are in each case dealing with the self-same lymph and leucocytes, this difference of results is imputable, not to our having in the lymph leech a different bacterial implantation, but to the negative pressure having furnished a larger proportion of blood fluids.

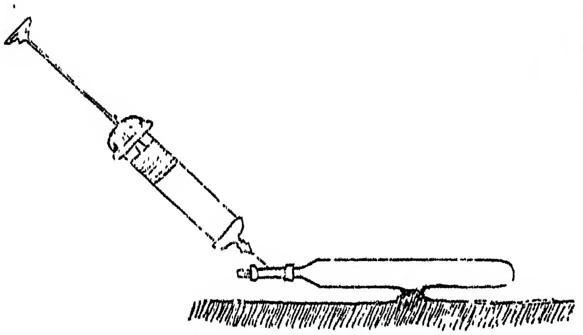

Fig. 3. Lymph leech in position, showing technique for exhausting the air.

But with this the problem is, as you see, only incompletely resolved. We have learned that the corruption of the lymph is not determined by the nature of the bacterial implantation; we have reason to think it is hindered by a larger afflux of lymph; and it looks as if it might have something to do with the breaking down of the leucocytes. But we have not yet put our finger upon the particular element that takes away from the serum its power of inhibiting microbic growth, and converts it into a congenial pabulum for all manner of micro-organisms.

Let me in this connection invite you to consider—for that may perhaps put us on the path for the solution of our problem—a scheme of classification of the albuminous substances. I would propose to classify them from the point of view of their capacity to furnish pabulum for microbes, and to distinguish three classes of albuminous substances. First would come *digested albumens*. It is familiar matter that these furnish very congenial pabulum for microbes. In the form of peptone we use them for all our artificial cultures. A second category of albumens would be *native albumens*. Muscle, milk, and eggs furnish such albumens. These are not like digested albumens, directly assimilable. Before they can be assimilated, whether by ourselves or by microbes, they must be broken down into simpler elements by digestion. To that end we, and a certain number of microbes also, are furnished with digestive ferments. There is yet a third class of albumens. I would venture to call these *defended* or *protected albumens*. These cannot, like the digested albumens, be directly assimilated. Nor can they, like the native albumens, be directly digested. They are specially defended against the attack of digestive ferments. The albumens of the serum fall into this class of "defended albumens." It is well known with respect to serum that it has an antizymotic, and in particular an antitryptic, power—a power of neutralising digestive ferments, and in particular trypsin. You will, perhaps, not immediately perceive that the fact that the serum is antitryptic in any way elucidates our problem. But let us take that fact and put it in another way and then consider. Let us, instead of saying that the serum has an antitryptic property, say that it has a power of preventing its constituent albumens being converted into pabulum for microbes, and immediately, as I think, light is projected upon our problem. For once we envisage the facts in that way we are immediately impelled to inquire whether the serum's power of inhibiting bacterial growth may not be due to its power of neutralising digestive ferments, and whether the corruption of the lymph in the cavity of the wound may not be due to a collapse of its defence against proteolytic attack.

That is a point which is very easily settled by direct experiment. And let me now show you what happens when we add trypsin to a serum which has been implanted with microbes. I have here two tubes of a serum implanted two days ago with a minute quantity of pus containing a variety of different microbes. To the one I added trypsin, the quantity added being less than that required to neutralise its antitryptic power. The other tube of the implanted serum served as a control. Both tubes were then placed in the incubator. And you see the difference. The trypsinised serum is turbid with microbic growth. That is, we have here exactly the same result as that obtained in our pyo-sero-culture in those volumes of serum which were corrupted by a heavy implantation of pus; and the same result also as was in the lymph leech experiment obtained in the discharges in the wound cavity. Our control serum has, as you see, remained almost perfectly clear. That is exactly the same result as was obtained in our pyo-sero-culture in the distal end of our tube, and again in our lymph leech experiment in the cavity of the lymph leech.

And the doctrine that the antitryptic power is the protector, and trypsin the corrupter, of the blood fluids wins further support from the following facts:—(1) In every suppurating wound there is, as we shall presently see, a source from which trypsin can be derived. (2) Blood fluids which inhibit microbic growth are strongly antitryptic; and blood fluids which we find teeming with microbes are tryptic. (3) Examination of the blood shows that all wounded men have a markedly increased antitryptic power, and heavily wounded men (you saw in our pyo-sero-culture what results from this) on an average a three- or four-fold increased antitryptic power. That clearly teaches that the body when endangered takes steps to protect itself non-specifically against all microbic infections of the blood fluids.

The Leucocytes.

I now pass on to consider the leucocytes and the part they play in the destruction of microbes. You already know with respect to leucocytes that they can emerge from the blood-vessels, burrowing their way out through small pores in the capillary walls; that they make their way to every focus of infection; that they ingest microbes when these have first been prepared by the action of the blood fluids; and, finally, that they can, if things go favourably, digest and dissolve the ingested microbes. There would by consequence in connection with the leucocyte be

three functions to study. First would come emigration, then phagocytosis, and lastly intracellular digestion. Emigration has up to the present been studied only in the interior of the organism You will realise that means that it has been studied only in a difficult setting and in the presence of all manner of disturbing factors, and you will appreciate that we want now a new and better technique. For we require for the treatment of the infected wound to find out how best to call out the leucocytes; and how, when occasion requires, to restrain their emigration.

I have in connection with this a technique to describe to you; but first I want you to appreciate what we can and what we cannot expect from leucocytes in the matter of locomotion. Leucocytes can, we know, make their way out through small openings. They can also travel over any ordinary surface. They can edge their way along faster when lightly compressed between two surfaces. They can crawl along strands, creep through a meshwork, and climb a scaffolding. But they are unable to climb a vertical glass wall. And again, they are unable to swim, and so once they get into open fluid they simply go to the bottom. We may liken them to very minute slugs crawling along surfaces and climbing trellises, but brought up short by any considerable barrier of fluid.

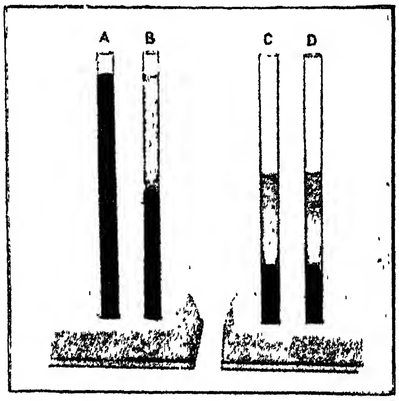

FIG. 4.—Drawing of four flattened capillary tubes. A, filled in with blood; B, a similar tube after centrifugalisation showing above the "white" and below the "red clot"; C and D, similar tubes after incubation. Leucocytic emigration is in each case visible to the naked eye as an opaque white band occupying the lower portion of the white clot. In D, where physiological salt solution had been imposed upon the white clot, the band of emigration is much broader than in C.

All these points must be considered when seeking for a technique for the experimental study of emigration, using for that study specimens of blood withdrawn from the body. The containing blood-vessel can up to a point be imitated by a glass tube, and we can, to facilitate observation, use tubes drawn out flat, such as shown in Fig. 4. But the artificial differs from our natural capillary in having impermeable instead of permeable walls. This, of course, makes emigration through the walls impossible. None the less, these tubes supply what we want for the study of the movements of leucocytes. We can institute races along the length.

But first certain preparations must be made. The course must be cleared of all obstructions—*i.e.* the red corpuscles must be got out of the way. Next the leucocytes must all be brought back behind the scratch line. Further, we must provide a scaffolding for the leucocytes to climb. All this can be arranged. We fill in our flat emigration tubes with blood and seal them at one end. Then, by centrifuging, we bring the blood fluids to the top and the corpuscles to the bottom. The lighter leucocytes will now have arranged themselves in a layer immediately above the red; and presently the supernatant fluid will clot and the meshwork of fibrin will then provide the scaffolding we require. We can now impose upon the clot—let me for convenience call it the white clot—any chemical agent we please and let it slowly diffuse down to the leucocytes. For the study of the effect of bacterial infection, we can introduce microbes into the blood before this is filled into the tube. Or, as an alternative, blood can be filled into tubes the walls of which have been wetted with a microbic culture. Finally, we set our experiment going by placing our emigration tubes in the incubator—that is, we supply to our leucocytes the necessary warmth. And we can at any moment take stock of what is occurring in our tubes by examining through the walls with the naked eye or with the low power of the microscope. Also, by a very simple technique we can extract the clot from the tube and mount and colour it, so as to bring everything clearly into view under the high powers of the microscope.

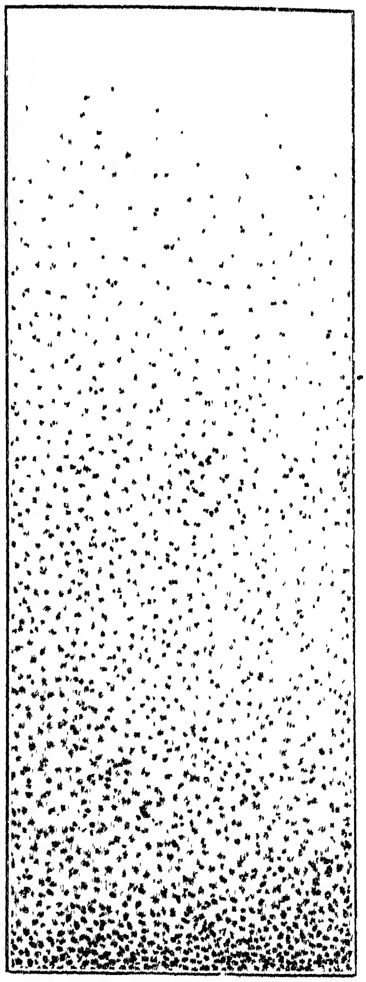

FIG. 5.—Magnified view of the band of leucocytic emigration seen in Fig. 4, D.

Emigration of Leucocytes: Facts with Practical Application.

I must limit myself to showing you in connection with emigration a few outstanding facts which have a practical application to the treatment of wounds. Let me begin with the naked-eye appearances. We have in Fig. 4, C and D, emigration tubes containing centrifuged blood which has been in the incubator for about eight hours. In C—the control tube—we have centrifuged blood to which no addition has been made. In D some weak salt solution has been imposed upon the white clot. The emigrating leucocytes are visible to the eye in the form of a slightly opaque white band extending upwards from the red into the white clot. You see that in D the corpuscles have climbed higher than in C.

Fig. 5 shows what such a band of emigrating leucocytes looks like under the microscope. Instead of the leucocytes being all, as you will see in the next figure, congregated together behind the starting line, they here are actively emigrating—the more active outdistancing the others in the race.

Fig. 6 shows what happens when 5 per cent. salt solution is imposed upon the blood. That salt passes

down by diffusion and arrests emigration, and I want you to notice on the right of the figure (and more clearly in the inset) that the few white corpuscles which were beginning to emigrate when the salt solution overtook them are broken up and destroyed. By that trypsin will be set free.

FIG. 6.—Magnified view of the leucocytic layer in the case where strong salt solution was superposed upon the white clot.

I next show you what happens when microbes have been implanted into the blood. Those microbes—supposing always that they are the sort that can proliferate in blood—grow out into colonies. In Fig. 7 is shown what happens when an excessive implantation has been made, and the bacterial colonies come up very

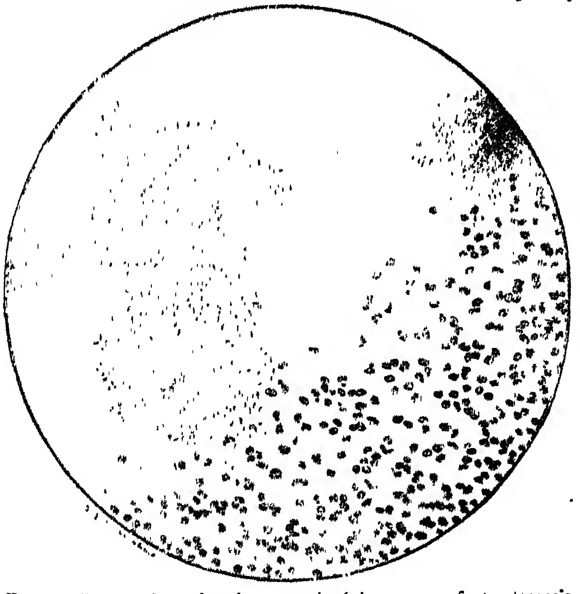

FIG. 7.—Leucocytic emigration restrained by excess of streptococcic infection.

thickly in the blood. You see here that emigration is entirely arrested. If that were to happen in infected tissues it would mean that the organism was there giving up the combat against the microbes.

In Fig. 8 we have again streptococcus implanted into the blood, but this time it is a much more sparing implantation. And here, as you see, the leucocytes are carrying out a raid against the microbes, each leucocyte ingesting and filling itself full with microbes.

In Fig. 9 I show you what happens when we make into the blood a very heavy implantation of the gangrene bacillus. Here in the neighbourhood of the leucocytic

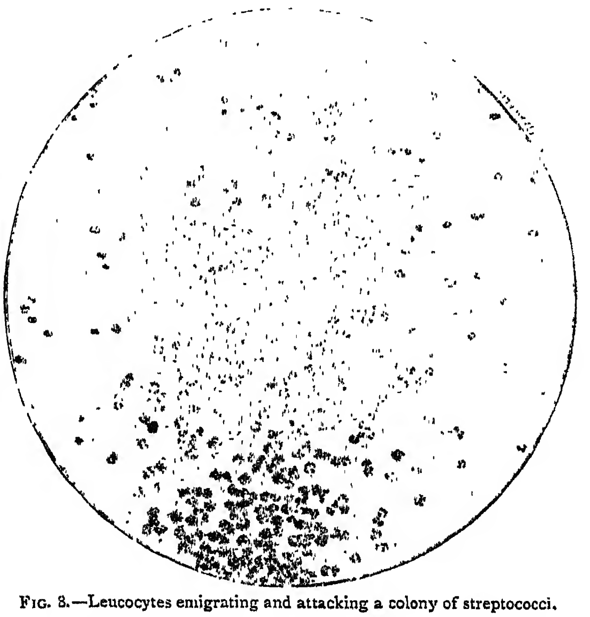

FIG. 8.—Leucocytes emigrating and attacking a colony of streptococci.

layer things are for the moment going well with the leucocytes, for they are actively phagocyting. But farther away from that layer there are very numerous colonies of the gangrene bacillus, which are growing unimpeded. The omens are consequently unfavourable. You can see in your mind's eye what is going to

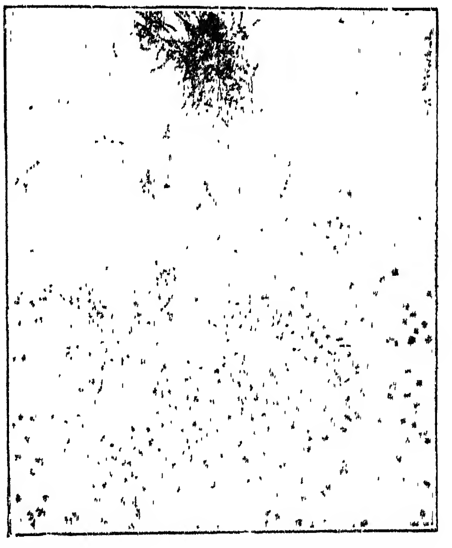

FIG. 9.—Leucocytes emigrating and attacking colonies of the gas gangrene bacillus.

happen. In the first place, all further emigration of leucocytes is going to be arrested; and, in the second, the leucocytes which have already emigrated and ingested microbes will, instead of successfully digesting them, be gradually poisoned by bacterial toxins. And when the leucocytes are killed, their

digestive ferment—trypsin—passes out into the serum. By that, the serum will, as we have seen, be converted into a medium in which microbes can grow and pullulate.

DISTINCTION BETWEEN "LIVE" AND "DEAD" SPACES.

But we must now come back from these general questions to that of the treatment of the wound. Let me begin by explaining to you—for important questions of treatment hinge upon this—the distinction between "*live spaces*" and "*dead spaces*."

In the lacunæ of vascularised tissues we have *live spaces*. In these we have optimum conditions for resistance to bacterial infection. We have here an antibacterial lymph; and by continuously renewed exudation corruptive changes will be continuously antagonised and made good. Again, in live spaces we have terrain that can be effectively searched by leucocytes; and if the bacterial infection should not be extinguished by the first leucocytic attack reinforcements of leucocytes can be supplied from the capillaries feeding the live spaces. In all these respects live and dead spaces are sharply contrasted.

Dead spaces are found in tissues which have been bruised and cut off from their blood-supply, in sloughs, in bone sequestra, and in the texture of cloth and intrusive foreign bodies. And we have a dead space in every abscess sac under every slough and scab, and also in every collection of pus lying open in the pockets of a wound. The essential characteristics of dead spaces are two. First, they cannot be effectively searched by leucocytes. In some cases chemical, in others mechanical, conditions stand in the way. Secondly, the leucocytes which are engaged cannot be reinforced, nor can the fluid be renewed. Isolation from the circulation makes this impossible.

Let me try to tell you in the fewest possible words what this imports in infection. If in an infected live space the scale turns in favour of the microbes, there is still a chance of the balance being redressed. At any rate, reinforcements can be brought up. In infected dead spaces—and let me here point out to you that all experiments conducted in test-tubes are equivalent to experiments conducted in dead spaces—an advantage gained by the microbes is irretrievable. Counter-attack is impossible.

Let me also tell you what happens to the patient when infection flourishes in a dead space. In the first place, bacterial poisons will be absorbed, and the patient will suffer from septic fever. In the next place, the microbic infection—this will generally be a streptococcic infection, but in war wounds it may be a gangrene-bacillus infection—will very often invade the surrounding tissues, and from thence the blood-stream. And in the third place, the pus in the dead space will, when it becomes tryptic, eat its way into the enclosing tissues. The containing sac will then extend in every direction, the pus in the case of an abscess burrowing in the direction of least resistance until it opens upon an inner or an outer surface.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—By the death of Arthur Cornwallis Madan, senior student of Christ Church, the University loses one who was not only an accomplished scholar in the usual sense, but also perhaps the chief living authority on the native languages of Central Africa. His work in connection with the Universities' Mission was carried on for many years both at Zanzibar and in the tropical interior, and resulted in the accumulation and arrangement of a large mass of valuable material, both philological and grammatical. Mr. Madan was the son of a Canon of Gloucester; one of his brothers is the learned and energetic Librarian of the Bodleian, and another (the late H. G. Madan), a fellow of Queen's, was for many years science master at Eton, and was well known as joint author with Mr. A. G. Vernon Harcourt, F.R.S., of an excellent manual of practical chemistry.

The Clothworkers' Company has undertaken to provide an addition to the University laboratories in the department of human anatomy, which will supply a dissecting-room for the use of women students. A woman assistant demonstrator will be appointed to teach under the general direction of the professor of human anatomy. It is hoped that the building will be available for use in October next.

THE sum of 1000*l*. has been bequeathed to the American Association for the Advancement of Science by Mr. W. H. Stephens, of Lowville, New York.

COLUMBIA University has received the sum of 10,000*l*. from Mr. G. W. Brackenridge, of San Antonio, Texas, which will make possible the opening of the doors of the university this autumn to women students.

AN educational campaign against tuberculosis throughout the Army at home and abroad has been undertaken by the National Council of the Y.M.C.A. The campaign will be conducted by means of information imparted in the huts of the association. Dr. H. Sutherland will inaugurate the work by giving an address on "Consumption: Its Causes and Cure," at the Central Institute of the Y.M.C.A., Tottenham Court Road, on Tuesday, September 4, at 7.30 p.m.

THE Tootal Broadhurst Lee Company has decided to set aside 10,000*l*. a year for five years for the promotion of research and education. According to the *Times* the provisional committee on research and education for the cotton industry will, at the close of the current holiday season, issue a prospectus of the new organisation. This definite industrial research federation of the cotton trade will be followed by the establishment of institutes and laboratories. It is also stated that a provisional committee to organise textile research associations in the woollen trade has been formed.

THE President of the Board of Education has appointed a departmental committee to inquire into the principles which should determine the fixing of salaries for teachers in secondary and technical schools, schools of art, training colleges, and other institutions for higher education (other than university institutions), due regard being had to such differentiation in respect of locality, duties, qualifications, sex, and other relevant considerations as is consistent with or necessary for the organisation of the teaching service throughout the country on a system conducive to the efficiency of national education. The committee is not asked to consider the question of the amounts by which existing salaries should be improved in particular areas or schools, or the sources from which the amounts required for that purpose should be provided.

WE have received from the British Esperanto Association, 17 Hart Street, W.C.1, an interesting pamphlet by Mr. Bernard Long, entitled "Esperanto and Why We Need It." Mr. Long considers that whatever relations may become necessary or desirable with our present enemies after the war, it would be better to use a neutral language, whenever possible, than to accentuate existing differences by employing any of the national tongues, with their attendant "atmosphere"

and associations. He strongly recommends Esperanto as a neutral language for this purpose, remarking that it is already well known both in Germany and in Austria-Hungary. Moreover, classes for Esperanto have been formed in many internment camps among both civilian and military prisoners. The knowledge of this auxiliary language has enabled prisoners of different nationalities to converse together. It is, indeed, to be expected that prisoners in a foreign country should keenly realise the advantages of a language common to themselves and their gaolers.

THE fourth annual meeting of the conference on New Ideals in Education was held, August 14 to 21, at Bedford College, London, under the presidency of the Earl of Lytton, and was, like its predecessors, largely attended by persons representative of a wide range of educational interests, lay and professional. The main subject of debate was the problems presented by the system of universal continuation schools now under the consideration of Parliament. The discussion was opened by the President of the Board of Education himself, who spoke of the continuation schools as a potential great "University of England," the best and most durable national memorial of the war, and invited missionary effort to commend the principles of his present Bill to popular opinion, and to secure its smooth working if it should be passed. In the subsequent sessions the conference considered the special problems that confront the urban and rural continuation schools respectively. With regard to the former, it was agreed that the main difficulty lies in the treatment of boys and girls condemned to monotonous unskilled labour, and that, in dealing with this great section of our juvenile population, educational cannot be separated from social and industrial reform.

THE report of the committee appointed by the North-East Coast Institution of Engineers and Shipbuilders upon the education of apprentices has now been issued, and has been accepted generally by the other engineering and shipbuilding associations in the north-east district. The scheme in brief provides for elementary education up to twelve and a half years of age approximately, followed by three years' full time at a junior technical school. The bulk of the boys (*a*) then proceed to ordinary apprenticeship with two or three half-days per week at continuation classes up to eighteen years of age; the best (*b*) are to spend half-time per week in the works and the other half in the technical college up to the same age. Group (*a*) then proceeds to ordinary apprenticeship with optional evening classes. Group (*b*) is divided again at eighteen years of age, the majority proceeding to ordinary apprenticeship with optional evening classes, while those of special quality proceed to the full applied science degree course leading to the B.Sc. in engineering or naval architecture. The details of the scheme comprise many interesting features. Junior day technical schools should be regarded as a distinct type of higher school, in no sense inferior to a secondary school; this point is to be urged upon the Board of Education by a deputation representing the Institution. An advisory committee is to be appointed to be associated with the management of the schools in a consultative capacity. Youths passing out of these schools are to have preferential treatment in the matter of appointment to apprenticeship. The latter point is of great importance, and if adopted throughout the country will be instrumental in the suppression of the premium system, and also of the method which some firms adopt of taking as apprentices without premium those lads only who are sons of employees, irrespective of their previous training. The scheme is excellent on the whole, and will provide facilities for any intelligent lad possessing grit to rise to the top of the educational ladder and to qualify for the highest posts no matter how lowly he may start. There is just one point open to criticism. The best lads who are selected for university courses will be handicapped at matriculation if no foreign language is taught prior to the age of sixteen. It would be well to include, say, two hours per week in the junior technical school curriculum; this would have the effect of bringing the products of these schools into line with secondary-school boys starting apprenticeship at sixteen. The report is well worth studying by all interested in education.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 30.—M. Paul Appell in the chair.—The president announced the death of M. F. C. Grand'Eury, correspondant of the section of botany.—G. **Bigourdan**: The propagation of the sound-wave produced by gun-fire to great distances. Direct determinations of the velocity of sound in the air could be made to-day over distances nearly ten times those utilised in the earlier experiments made between 1736 and 1822.—H. **Le Chatelier**: The tempering of steel. Summarising recent researches by Portevin, Chevenard, and Dejean, the author concludes that, starting with the eutectoid with 0·8 per cent. carbon, initial state austenite, the final state may be perlite with slow cooling, troostite, martensite, or austenite being the final products as the rate of cooling is increased. The last case can only be practically realised in the presence of 2 per cent. of manganese or a slightly higher proportion of nickel.—M. **Balland**: The alterations of biscuit bread. The flour used is the same as that of which ordinary bread is made, but it is baked in a cooler oven for a longer time. It has a thicker crust, highly resistant to the action of external influences, and keeps good for from fifteen to twenty days.—A. **Nodon**: Observations on the eclipse of the moon of July 4, 1917. The observations were made at Bordeaux under good atmospheric conditions, and the results appear to indicate a luminosity due to the surface of the moon.—E. **Belot**: The physical and ballistic history of the lunar volcanoes.—M. **Portevin**: The carburation of iron by alkaline cyanides and cyanates. At temperatures of 750° C. and 900° C. the addition of a proportion of cyanate to potassium cyanide results in a considerable increase in the amount of carbon taken up by the iron.—P. **Dejean**: The formation of troostite and martensite.—A. **Colani**: The action of metaphosphoric acid upon the oxides of molybdenum. At a red heat metaphosphoric acid acts upon MoO_3, giving a slight reduction and evolution of oxygen.—H. **Travers**: The rapid estimation of manganese and chromium in metallurgical products. The method is based on oxidation with ammonium persulphate and subsequent titration with sodium arsenite and is applicable to certain chrome steels.—L. **Vialleton**: Ontogenic relations of the pelvic and thoracic bands in the tetrapod vertebrates.—A. **Lécaillon**: The signification of the colour-changes normally produced in certain non-impregnated eggs of *Bombyx mori* and the formation, in this species, of true caterpillars of parthenogenetic origin.—H. **Colin**: The antiseptic properties of nitrous fumes. In the absence of oxygen, nitric oxide is devoid of antiseptic properties. The contrary results obtained by Priestley were due to nitric acid produced by the simultaneous presence of air and water.—P. **Portier**: Researches on symbiotic micro-organisms in the animal series.—MM. **Weinburg** and P. **Séquin**: Serotherapy of gas gangrene in man. An account of the favourable results obtained by a mixed serum.—P. **Armand-Delille**: Remarks on the parasitological aspects of malaria contracted in Macedonia.

August 6.—M. Paul Appell in the chair.—A. **Lacroix**: The granulated rocks of a leucitic magma studied with the aid of the holocrystalline blocks of the Somma.—G. **Humbert**: The continued fraction of Stephen Smith.—H. **Le Chatelier** and B. **Bogitch**: The refractory properties of silica. Work supplementary to results published in an earlier paper (*C.R.*, 1917, p. 64). A brick made from refractory clay, crushed at a temperature of 1500° C., flattened and showed rounded edges, whilst, with silica, the first action of the pressure produced no appreciable effect. On breaking the test piece by increasing the pressure, the pieces corresponded in shape with those normally observed with hard materials. Good silica bricks contain between 3 per cent. and 5 per cent. of basic oxides, and the weight of sulphates obtained after attack by hydrofluoric and sulphuric acids is between 8 per cent. and 14 per cent. Results are given of the resistance to crushing after one hour at 1600° C. of a number of good commercial silica bricks.—P. **Sabatier** and G. **Gaudion**: A new case of reversible catalysis: direct formation of nitriles starting from amines of the same carbon chain. Benzylamine passed in the state of vapour over reduced nickel at 300° C. to 350° C. is converted into benzonitrile, toluene, and ammonia, one-third of the amine being converted into the nitrile. *iso*Amylamine behaves similarly.—H. **Hildebrandson**: Some remarks on the possible influence of violent cannonades on rainfall.—J. **Guillaume**: Observations of the sun, made at the Observatory of Lyons, during the first quarter of 1917. Observations were made on sixty-four days, and are grouped in tables giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A. **Colani**: Study of the system: water, uranyl oxalate, ammonium oxalate.—E. **Rengade**: The purification of salts by *clairçage* or by fractional crystallisation. The word *clairçage* is applied to the displacement, by means of water or an appropriate solvent, of the impure mother liquor impregnating the crystals. The case of ammonium nitrate mixed with a small proportion of sodium chloride is discussed in detail, the reactions being followed microscopically.—A. **Cochain**: The existence of an approximate centre of symmetry in the figure formed by the directing lines of the Alpine system. The tectonic interpretation of this quasi-symmetry.—J. **Deprat**: The frontal zone of the preyunnanaise sheets in the regions of Bao-lac and Cao-bang.—J. **Amar**: The physiopathology of *effort*. *Effort* is defined as a maximum muscular action generally sustained, sometimes instantaneous. The present paper deals with the relations between respiration and effort both in the normal and pathological states.—O. **Bailly**: Does the law of mass-action govern diastatic reactions? Earlier work has been in the direction of measuring the reaction-velocities of diastatic reactions: the author gives reasons for preferring to study the final equilibrium state, and for this it is necessary to choose reversible diastatic reactions carried out in homogeneous media. The case chosen is the synthesis and hydrolysis of β-methylglucoside, making use of the experimental data of Em. Bourquelot and Em. Verdon, and here the experimental values and those calculated from the law of mass-action are in good agreement.

CAPE TOWN.

Royal Society of South Africa, June 20.—Dr. L. Péringuey, president, in the chair.—H. V. **Exner**: A case of hermaphroditism. A description of the body of a person of unsound mind, who had the outward appearance of a Kaffir girl.—I. B. Pole **Evans**: The genus Terfezia. A truffle from the Kalahari. Chœromyces, a truffle hitherto unknown to Africa, has recently been reported from South Africa. It was pointed out that the best known South African truffles belong to the genus Terfezia. The distinction between Chœromyces and Terfezia was indicated, and a description given of a truffle (*T. Claveryi*, Chat.) recently sent from the Griqualand West district in the Kalahari.

BOOKS RECEIVED.

The Theory and Use of Indicators: An Account of the Chemical Equilibria of Acids, Alkalies, and Indicators in Aqueous Solution, with Applications. By Dr. E. B. R. Prideaux. Pp. vii+375. (London: Constable and Co, Ltd.) 12*s*. 6*d*. net.

Bureau International des Poids et Mesures. La Mesure Rapide des Bases Géodésiques. By J. R. Benoît and C. E. Guillaume. Cinquième édition. Pp. 283. (Paris: Gauthier-Villars et Cie.)

The Thyroid Gland in Health and Disease. By Dr. McCarrison. Pp. xvii+286. (London: Baillière, Tindall, and Cox.) 12*s*. 6*d*. net.

Stanford's Half-inch Map of the Battle Front: Ostend, Zeebrugge, Bruges. (London: E. Stanford, Ltd.) 2*s*. 6*d*.

Laws of Physical Science. By Dr. E. F. Northrup. Pp. vii+210. (Philadelphia and London: J. B. Lippincott, Ltd.) 8*s*. 6*d*. net.

Standard Method of Testing Juvenile Mentality by the Binet-Simon Scale. By N. J. Melville. Pp. xi+142. (Philadelphia and London: J. B. Lippincott, Ltd.) 8*s*. 6*d*. net.

Standard Methods of Chemical Analysis. By W. W. Scott and others. Pp. xxxi+864+plates iii. (New York: D. Van Nostrand Co.; London: Crosby Lockwood and Son.) 30*s*. net.

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THURSDAY, AUGUST 30, 1917.

SCIENCE AND SOCIETY.

Annals of the Royal Society Club. The Record of a London Dining-Club in the Eighteenth and Nineteenth Centuries. By Sir Archibald Geikie. Pp. xv+504. (London: Macmillan and Co., Ltd., 1917.) Price 18s. net.

THIS is a delightful book, not only for fellows of the Royal Society, not for scientific circles only, but for all those who love the biographical side of history, varieties of manners, and the characters of English folk. Moreover, the story of the Royal Society, and of the Club, its inner and more sociable group, is concerned with the most interesting section of English society; or, to be quite modest, let us say of the English society of the eighteenth and nineteenth centuries. No person, whatever his rank, could find admission to this circle without intellectual distinction, while with such distinction none was of origin too humble to fail of a welcome. And, from its beginning onwards, the Club was habitually entertaining as its guests the most distinguished men of the day.

It is impossible to fix the date of the origin of the Royal Society Club, for, like most of such bodies, it grew rather than was founded: it grew out of such tavern parties as Samuel Johnson loved. It took definite form about 175 years ago, when it was called the "Royal Philosophers," a name abbreviated to "The Royals." After some changes from tavern to tavern the Club settled down at the "Mitre," in Fleet Street, and stayed there for forty years. The title of "Club" crept in, at first colloquially, then was formally adopted. The hour of dinner slowly descended from 4 o'clock to 6.30, where it still remains.

The sketch of the history of the Club by Admiral Smith, pleasing and genial as it is, still is but a sketch. For the fuller history before us the Club most happily found its annalist—for in the form of annals the book is written—in Sir Archibald Geikie, during whose presidency the Royal Society had a representative almost as distinguished in literature and humanity as in science. Sir Archibald Geikie knew intimately the sources of his illustrative materials—in Horace Walpole, Boswell, Mme. D'Arblay, Sir Henry Holland, the "Dictionary of National Biography," and so forth. From these and other records he has written a volume which will not by any means be confined to the circle for which in the first instance it was written.

Not the least of its attractions is the series of portraits—thirty-nine in number; among them a print of Hogarth's fine portrait of Martin Folkes (president 1741–52). Hogarth dined more than once with the Club.

The records of the Club, a few gaps apart, have been kept with care, the earlier volumes daintily bound in red morocco. In them we read of much hearty feasting and good fellowship. Gifts of venison at times were so abundant that extra meetings had to be held for the eating of them. Mr. Hanbury is thanked for "a mighty chine of beef of 112 lb. weight," a joint at which Lord Rhondda would gravely shake his head; in 1754 Lord Anson from the Admiralty sent a turtle which weighed 115 lb.; afterwards gifts of these succulent cattle, from him and other friends, became more frequent. Lord Marchmont more than once bestowed on the Club a "particular dainty in the shape of pickled salmon, as sent to the East Indies." A specimen bill of fare at the "Mitre" on January 23, 1758, was as follows:—

Present: Earl of Macclesfield (president), Earl of Morton, Lord Willoughby, Lord Charles Cavendish, Mr. Burrow (treasurer), and other nine members and three guests.

Veale Soup	Soup and Bouille
Fresh Salmon and Smelts	Cod and Smelts
Two dishes of Chickens	Ham
Boiled Turkey and Oyes^{trs}	Rump of Beef aladobe (à la daube)

Lamb pye with Cocks-combs, etc.

Lord Macclesfield was a mathematician and astronomer of some distinction.

Among the guests at various dates we find, taken at hazard, General Oglethorp, the friend of Johnson, Laurence Sterne, Pennant, Benjamin Franklin, Poniatowski, the Duc de Nivernais, Helvetius, Captain Cook, Paoli and Boswell, and, among scores of others, Henry Cavendish, who dined more than once as the guest of his father, Lord Charles Cavendish. This friendly record, and that of the proposal of Henry on one of these occasions as a member of the Club, may take their place with the evidence of other memorials, such as joint laboratory work, to refute the story that the relations between father and son were not quite harmonious. Sir Archibald draws a vivid picture of Henry Cavendish, an odd, pathetic figure, shrinking from society, indifferent to fame, yet seeking in his constant attendance at the Club table a relaxation from his studies and a relief from his solitude.

Partly on account of the long waiting list of the Club, partly to combine more formally intellectual discussions with the convivial, in 1847 the Philosophical Club was founded—in no rivalry with the Royal Society Club, for many fellows of the Royal Society were members of both clubs. Ultimately, however, in 1901, the new was merged in the parent club, the prosperity of which continues unabated. Its present "tavern" is Prince's Restaurant, in Piccadilly.

Full of social gossip, gracefully and humorously told, this volume may be cordially recommended to all readers interested in the last two centuries of English home life. And to them another and a pregnant reflection may occur, namely, the great place, the dominant place perhaps in British science, of the amateur. If in certain respects this character of us has been, and yet may be, a source of weakness, in others, and especially in originality and touch with life, it has been a precious tradition. In the pursuit of science more drudgery and more business are now required of us, but let us hope these may be gained without suffering the narrowness and harshness of an army of mere experts.

C. A.

RINGS.

Rings for the Finger: From the Earliest Known Times to the Present, with Full Descriptions of the Origin, Early Making, Materials, the Archaeology, History, for Affection, for Love, for Engagement, for Wedding, Commemorative, Mourning, etc. By Dr. G. F. Kunz. Pp. xviii+381. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 28s. net.

THE author of the volume before us is well known as one of the leading authorities in the world on all that pertains to the æsthetic and scientific aspects of jewelry. If our memory has not misled us, in the preface to one of his books he claims to possess a collection of literature relating to precious stones and jewelry which, in point of view of extent and completeness, is unsurpassed by any other private library. Unlike not a few owners of large libraries, he evidently does not allow the volumes to lie idle on the shelves; he takes them down and reads them, and notes down any item that strikes him as of unusual interest. His teeming notebooks have provided material for a series of books on subjects connected with jewelry, and now in this sumptuous volume, which is issued at a correspondingly sumptuous price, he pleasantly and discursively treats of an article of ornament that has for countless years played a conspicuous part in the domestic and ceremonial life of man—and especially woman.

The origin of the ring is wrapped in obscurity. Dr. Kunz thinks that it may have been evolved in either or both of two ways. In very early times it was the practice to carry on the person a cylindrical seal, and no doubt it occurred to someone that a convenient way of carrying it was to place it upon the finger. Another likely source was the knot; the true-lovers' knot is familiar to-day, and a twisted piece of metal wire or a knotted cord was a favourite talisman in primitive times. The ring as we know it now has not been traced back farther than the Bronze age. Some sixteen years ago M. Henri de Morgan discovered in the valley of Agha Evlar, near the Caspian Sea, several sepulchral dolmens which, when opened, were found to contain a considerable number of metal, stone, and glass ornaments, among them being bronze rings. They are supposed to date back to about 2000 B.C., but the date cannot be fixed because of the lack of inscriptions. The rings found in the tombs at Enkomi, Cyprus, can be dated with greater precision; they are of Egyptian manufacture, and belong to the period of about 1400–1000 B.C. There appears to be no doubt that the manufacture of rings originated in Egypt and spread thence to Greece and to Italy. Among the Romans the wearing of rings was at first rigidly confined to senators and the patrician class, and it was not until the third century A.D. that these restrictions were swept away. The early form of ring was very simple, consisting merely of a bent piece of wire fastened to the scarab or whatever was the object worn; complete rings appear to have been first made in the Golden age of Egyptian civilisation.

When the author passes on to the other topics discussed in the book, such as signet rings, interesting rings, betrothal and religious rings, and rings used as talismans or for healing, he traverses ground already to some extent trodden in his previous works. Some interest attaches to a form of ring seldom seen to-day, viz. the hololithic, *i.e.* one which is wholly—circlet and chaton—cut out of a single stone. Such rings were, however, common in days of archery, when rings made of agate or chalcedony were used to protect the thumb of the hand holding the bow from being cut by the string as it straightened after the arrow had sped on its course. Five rings of the kind made of agate, carnelian, mocha-stone, or jasper were included in the collections which were bequeathed to the nation by Sir Hans Sloane in 1753 and led to the formation of the British Museum. The most wonderful hololithic ring on record is one measuring about 1½ in. in diameter and cut from an unusually beautiful emerald; dependent from it are two fine emerald drops, and rose diamonds bordered with rubies are set in two collets. It was made to the order of the great Jehangir Shah, and was engraved with his name. After passing through many vicissitudes the ring was given to the British East India Company by the unfortunate Shah Shujah, and was afterwards acquired by Lord Auckland.

In the last chapter the author describes carefully the modern manufacture of rings by means of machinery, and illustrates the various stages from the wire to the finished article. Some idea of the magnitude of the industry may be gauged by the fact that a single factory in the United States has turned out upwards of three million rings in a year.

Dr. Kunz in the course of the book describes many of the more famous rings contained in the British Museum collections, and constantly refers to the catalogues of the rings in that institution. He gives a facsimile of a sketch made by Sir C. H. Read of a seal-ring on a finger of a bronze statue of the third or fourth century. A curious mishap has occurred on p. 86, probably in the course of paging the book: the last five lines at the foot of the page, excluding the foot-note, should have been inserted in the middle of the page. Possibly had the publication of the book been delayed a few months the following sentence on p. 160 might have been worded a little differently: "The gems with which they are set were bought by the Rev. Dr. John P. Peters from an Arab in the Kut-el-Amara region, where the British invaders of Mesopotamia underwent such a disastrous defeat." The illustrations to the book are, from the point of view of reproduction, of exceptionally high quality, but they appear to have been selected a little at random. It is not clear why a letter from Admiral Peary and one from Sir Sidney Lee and Mr. F. C. Wellstood were reproduced in facsimile; they really add nothing to the value or interest of the book. There is an excellent index.

TWO BOOKS ON MINERALS.

(1) *A Pocket Handbook of Minerals, Designed for Use in the Field or Classroom, with Little Reference to Chemical Tests.* By Prof. G. Montague Butler. Second edition. Pp. ix+311+table in 5 folding sheets. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., n.d.) Price 11*s.* 6*d.* net.

(2) *Microscopical Determination of the Opaque Minerals: An Aid to the Study of Ores.* By Dr. J. Murdoch. Pp. vii+165. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 9*s.* 6*d.* net.

THESE two books form a useful addition to the already large number of American publications on determinative mineralogy.

(1) Prof. Butler's volume, now in its second edition, is specially designed for use in the field, and can easily be carried in the coat-pocket. A brief account is given of each mineral, and there is a useful table of the most characteristic properties of the different species, so that the recognition of a specimen should as a rule present little difficulty. The table does not, however, include specific gravity, one of the most generally useful means of identification. Even in the field a Walker's balance, or for smaller specimens the simple arm balance employed by Penfield, is available. The work appears on the whole to have been well done, though in a book containing so much detailed information there are naturally some points open to criticism. Oligoclase is described quite correctly as Ab_6An—Ab_3An, but a note is added that $Ab = Na_2O.Al_2O_3.6SiO_2$ and $An = CaO.Al_2O_3.2SiO_2$. This is misleading, for according to general usage Ab only represents half the amount of albite indicated by the former formula. Garnierite is not now the most important ore of nickel. The "compact fibrous masses" of crocidolite (blue asbestos) resemble in structure, not ordinary amphibole asbestos, but serpentine asbestos (chrysotile, better referred to by its older name, karystiolite). Again, it is not much use giving the value of precious stones per carat without specifying the size.

(2) Dr. Murdoch's book, on the other hand, is intended as a guide to students who wish to study the structure and composition of the opaque metallic ores in the laboratory, by examining the polished surface under the microscope. There is a useful introduction describing the methods employed and the results that can be obtained, followed by tables for identification. The first classification is by colour, the next by hardness, and the third by the behaviour with reagents. Königsberger's earlier method of observing the optical characters of opaque minerals in polarised light is described, but not his later method (*Centralblatt für Min.*, etc., 1909, p. 245), which promises to be of more general utility.

J. W. E.

OUR BOOKSHELF.

A Manual of Field Astronomy. By Andrew H. Holt. Pp. x+128. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6*s.* net.

THIS is a handy and lucid manual dealing with all the problems that arise in field work with a theodolite, namely, determinations of altitude, latitude, azimuth, time, and longitude. It contains a useful list of formulæ for obtaining any element of the astronomical triangle in which three elements are supposed to be known. Attention may be directed to the unusual notation; the polar distance, zenith distance, and colatitude are called z, p, and s respectively; this is because they are opposite the points Z, the zenith, P, the pole, and S, the star. The explanations refer throughout to the American Ephemeris, but the arrangement of the British Nautical Almanac is so similar that they will serve equally for it. All needful corrections, such as parallax and refraction, are explained, but the author deliberately refrains from introducing refinements that are of no importance for work in the field. It is evident from a study of the examples that the degree of accuracy contemplated by the author is only of the order of the nearest 10″. A considerably higher degree of accuracy is attainable with field instruments of the finest type, but the methods explained in the book will suffice, if carefully followed, to give this greater refinement.

An appendix explains the use of the "solar attachment," which is designed to solve the astronomical triangle mechanically, and give a direct determination of the meridian from an observation of the sun at any time. The accuracy attainable with it is stated to be not much greater than the nearest minute of arc.

ANDREW C. D. CROMMELIN.

Stanford's Half-inch Map of the Battle Front in France and Flanders: Ostend, Zeebrugge, Bruges. War Map No. 23. (London: E. Stanford, Ltd., 1917.) Price 2*s.* 6*d.*

THIS sheet is a continuation northward of the map of the British battle front in France and Flanders previously published by the same firm. It extends from Dunkirk in the west to within six miles of Flushing in the east, and southward to the latitude of Roulers, and so comprises the greater part of the plain of Flanders. There is little high ground in this region, and the only contour shown is that of 125 ft. All the ground above that height is stippled light red. The method is successful so far as this sheet goes but on higher ground done on a uniform method the depth of colour would obscure the map. There are no spot heights, but they are scarcely required in Flanders. Woods, lakes, and marshes are shown by conventional signs without colouring. Roads, railways, and canals are clearly marked. As regards roads, apparently there is a differentiation into main-roads, by-roads, and tracks. This, however, is not stated in the ex-

planation. There are sufficient names, but crowding has been avoided. The British front in June is shown by a red line. It is a clearly printed and useful map with a great amount of detail, and allows the progress of operations, both on the Belgian front and along the coast, to be closely followed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Forecast of Coming Winters.

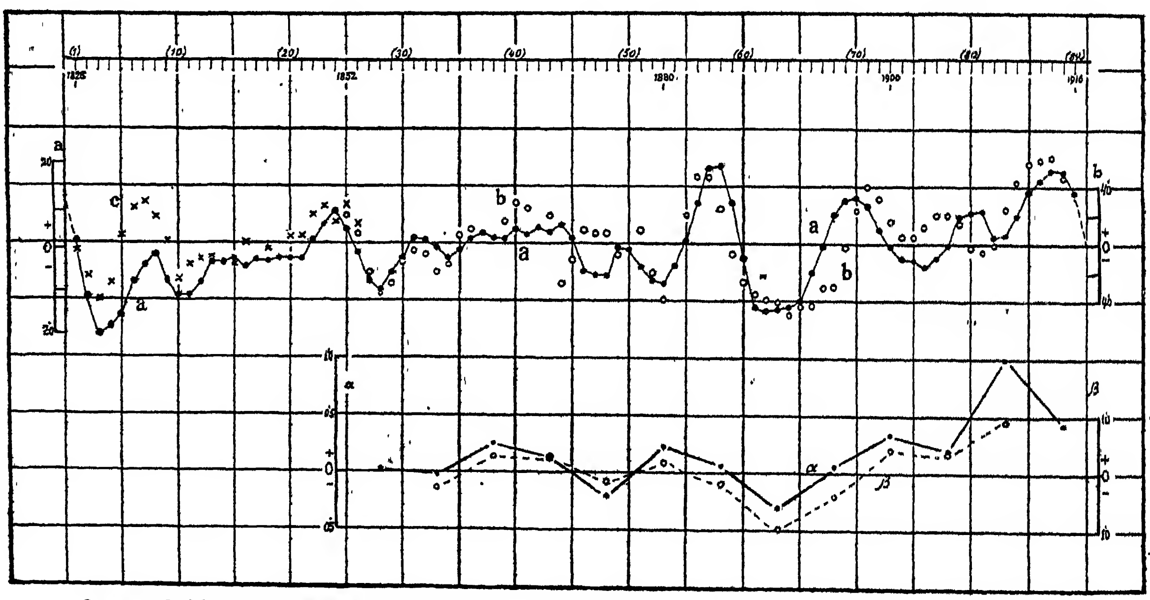
A STATISTICAL examination of ancient records of winter temperatures in Western and Western-Middle Europe led me to the conclusion, in 1904 and 1905, that periodicities of $44\frac{1}{2}$ and 89 years have the greatest influence on the occurrence of mild and severe winters in this part of the world. These periodicities, undoubtedly related to similar fluctuations in the sun's activity, are especially manifest in lower winter temperatures at the beginning, and in higher winter temperatures in the latter part, of the periods. Thus, in the 89-year period 1828–1916, the winter temperature is generally lower in the first and third 22-year interval, and comparatively high in the second and fourth; the interval 1828–49 being the coldest, the interval 1895–1916 the warmest part of the whole period. Not only the monthly means, but also the frequency of mild and severe winters, show this periodicity.

So early as 1905 I pointed out[1] that a series of warm winters might be expected in the following years, according to these statistics, and that the year 1917 marked the beginning of a new period of *comparatively* cold winters. Though it seems a matter of mere chance that exactly the winter 1916–17 turned out to be the first cold winter after so many mild winters as we experienced since the beginning of this century, the first really cold winter since 1895 in W. Europe; nevertheless, a change in the weather-type about this time is in perfect agreement with the forecast.

Since the publication of my first paper on this subject I have been collecting and critically examining all materials on winter temperature that are available on the Continent and in England, in order to trace the *vera causa* that must lie hidden behind such a period or complex of periods. I did not, however, succeed; even the Fourier analysis, applied to these data with the kind assistance of Dr. Van der Stok at the R. Institution of Meteorology, in De Bilt, failed to give a clue.

There remained, however, a means of testing the reality of the suspected 45-year or 89-year periodicity. If this periodicity were real, the curve representing the thermometrical observations, made during the latter half of the nineteenth century, at some representative stations in W. Europe, *e.g.* Paris and Utrecht (De Bilt), should fit in with the 89-year curve derived from the "historical data." The result of such a comparison can be seen in the diagram, where the full-drawn line "a" gives the "historical" 89-year curve, "b" (dotted) the "thermometrical" curve since 1852, the crosses marked "c" having been added in order to trace back the instrumental records to the year 1828, although this part of the curve had to be taken from less trustworthy data. All this applies only to the western part of Europe. The curves α and β represent the same data since 1852, simplified and smoothed. Making allowance for a certain shifting of the phase in the latter part of the curve, the dips and crests show, I think, so much analogy as to preclude a purely accidental conformity of the two curves, compiled from absolutely different data.

Want of space compels me to refer the reader to my paper, just issued by the Amsterdam Academy of Sciences.[2] I must now confine myself to give a table showing the frequency of cold and severe winters in periods of 22 ($22\frac{1}{8}$) years since A.D. 760; period



89-year periodicity of winter-temperature in W. Europe. "a" and α (full-drawn lines), historical; "b," "c" β, instrumental data.

[1] "Oscillations of the Solar Activity and the Climate" (Proc. Roy. Acad. Sci., Amsterdam, vols. vii.–viii., 1904–5).

[2] "Periodicity of Winter Temperatures in Western Europe since the Year 760" (Proc. Roy. Acad. Sci., Amsterdam, vol. xxv., 1917).

No. XIII. thus running from 1828 to 1916. The deficiency of severe winters in the last column is striking.

Frequency of (a) Cold, (b) Severe Winters, 760–1916.

89-year Period	Period-year 1–22		Period-year 23–45		Period-year 45–67		Period-year 68–89	
No.	Cold	Severe	Cold	Severe	Cold	Severe	Cold	Severe
I.	1	(1)	0	(0)	1	(1)	0	(0)
II.	1	(1)	1	(1)	2	(1)	2	(0)
III.	2	(1)	1	(0)	3	(1)	1	(0)
IV.	3	(1)	2	(0)	2	(2)	1	(0)
V.	3	(1)	2	(1)	2	(1)	0	(0)
VI.	5	(2)	1	(1)	3	(1)	1	(0)
VII.	2	(1)	3	(1)	2	(0)	1	(1)
VIII.	3	(0)	2	(1)	3	(2)	2	(1)
IX.	1	(0)	2	(1)	2	(0)	1	(0)
X.	2	(1)	2	(0)	2	(2)	0	(0)
XI.	4	(1)	1	(1)	3	(1)	0	(0)
XII.	1	(1)	3	(0)	4	(3)	1	(0)
XIII.	2	(1)	2	(0)	2	(2)	1	(0)
VIII.–XIII.	2·2	(0·7)	2·0	(0·5)	2·7	(1·7)	0·8	(0·2)
I.–XIII.	2·3	(0·9)	1·7	(0·5)	2·4	(1·3)	0·8	(0·2)

The conclusions of the whole investigation may be summarised as follows (all this relates, of course, to winter temperatures in W. Europe):—

(1) Within each interval of 44½ years (759·5–803·0 . . . 1872·0–1916·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 20° per 44 winters; after the year 1383 on an average 26°.

Exceptions, or apparent exceptions, from this rule, two out of twenty-six cases since 760, none since 1200.]

(2) Within each interval of 89 years, to begin with the year 759·5 (1827·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 22° per 89 winters. Exceptions from the rule, two out of thirteen cases since 760, besides two doubtful ones; since 1116 one exception.]

(3) The chance that the last quarter of an 89-year period (826·25 848·5 . . . 1894·25–1916·5) contains a smaller number of hard winters than the preceding and following 22-year intervals is 0·88. Within the last quarter of an 89-year period the chance that any winter will be severe (or very severe) is less than 0·4 (or 0·007), *i.e.* less than ½ (⅕) of the general chance. In the neighbouring 22-year intervals (*e.g.* 1872–93 and 1916–37) this chance is about three (five) times as great.

(4) Increased and accelerated activity of the solar surface corresponds in general with the winter-cold in Western Europe setting in more forcibly and quickly than usual; inversely, a weakened and retarded activity of the sun corresponds with winters setting in more mildly and in a later part of the period.

The forecast for the period 1917–38, derived from these statistics, indicates at least two very cold and one severe winter; the average winter temperature for these twenty-two years being generally below the 89-year mean. C. EASTON.

Amsterdam, June, 1917.

Auroras and Magnetic Storms.

WITH reference to your note in NATURE of August 16 referring to a magnetic storm on the night of August 9–10, it may be of interest to learn that an aurora was seen here that night. It was first seen a few minutes before 10 p.m. (G.M.T.), when it appeared as a glow in the northern sky. Two streamers were just discernible at first, but they gradually increased in numbers and became clearer, at the same time growing longer and brighter and moving towards the west. The longest reached to the centre of the Great Bear. Small, sharp, and delicate streamers, although not prominent, were distinctly seen in the larger streamers. There was no colouring seen at all, but merely a white glow. By 11.15 all traces of it had vanished. L. CAVE.

Testing Squadron, Royal Flying Corps, Martlesham Heath, Suffolk, August 21.

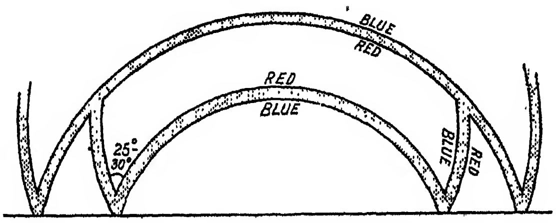
An Unusual Rainbow.

AN unusual rainbow display was visible at sea between 6.30 and 7 p.m. on the evening of August 16. The primary and secondary bows were complete and of exceptional brilliancy. Between these two lay two arcs of a third bow, cutting the primary bow near the horizon and ending in the secondary bow about 20° above the horizon in the manner shown in the accompanying diagram.

The blue of this bow was towards the primary bow, and the red towards the secondary bow. This third bow cut the primary bow at an angle of 25°–30°.

Outside the secondary bow were visible two arcs of a fourth bow (less distinct than the others) which cut the secondary bow in much the same way as the third cut the primary.

Unfortunately, I am unable to give you at present



the ship's position at the time when the phenomenon was seen. The sun's altitude was about 7° when the bows were most clearly seen. The afternoon was warm and sultry and there was practically no wind. A thunderstorm took place at some distance from the ship during the afternoon.

I shall be glad if any of the readers of NATURE can give me an explanation of the phenomenon, which has caused considerable discussion among the officers of the ship. ALLAN J. LOW.

August 16.

An Invasion of Ants.

YESTERDAY afternoon (Bank holiday) the weather suddenly became brilliantly sunny and very hot, after some days of gloom with rain and thick east wind atmosphere; and about five o'clock I became aware that apparently every ants' nest in the garden had chosen that precise moment for the emergence of its winged inhabitants. There they were in myriads, swarming out of holes in the drive, gravel paths, flagstones, the rock-garden, where they had been devastating Sempervivum clumps, and all over the lawns. They were nearly all the small red ant, only a few nests of the small black one.

The tiny winged males much outnumbered the large-bodied winged females, and both were attended by fussily anxious "workers"; by seven o'clock all were gone. Can ants delay their appearance above ground until the onset of suitable hot, dry weather?

ELEONORA ARMITAGE.

Dadnor, Herefordshire, August 7.

THE appearance in swarms of male and female ants for the nuptial flight is described by many observers.

References will be found, for example, in Mr. H. K. Donisthorpe's recent book on "British Ants" to the species *Myrmica rubra* and *Lasius niger*, which are probably those noticed by Miss Armitage. Her observation is of interest in showing how the workers direct the exodus of the winged forms when weather conditions become favourable.—EDITOR.

THE ADOPTION OF THE METRIC SYSTEM.

THE controversy with reference to the metric system appears to have passed through two stages and to be approaching the climax of its third, and possibly final, stage. In the first stage the glamour of its uniformly applied denary scale, and of its carefully related standards of length, area, volume, and weight, carried the general public in an apparently wholehearted advocacy which was clearly reflected in the early divisions on the Metric Bill in Parliament. Advocates of the binary scale might attend metric meetings and tear up sheets of paper into two, four, and eight parts; theorists with the duo-denary scale might drag a red-herring across the trail; workers with the most convenient of the English weights and measures might voice their fears of a bad exchange in units of measurement; but the metric advocates carried the day, in most cases with a wonderful accompaniment of popular, if not business, enthusiasm.

The second stage was reached when the practical business men were actually forced to take cognisance of the movement and either accept, or work vigorously against, it. The natural thing happened—how could it be expected that British controllers of industry—industry inductively developed—should be other than short-sighted and insular in their ideas? The nation which deliberately attempted to cut itself off from the Continent in the sixteenth century by adopting a different Latin pronunciation was not likely in the nineteenth to be ready to accept at once any Continental standard, even in weights and measures. Every conceivable objection was raised—and it is perhaps as well that this was so; for we now understand much more clearly the "pros and cons" of the case.

Possibly the greatest difficulty, which has still to be overcome, is the inborn tendency not only of British, but also of all traders to vary their trading conditions. "Tare and *tret*" accounts have only just vanished from our book-keeping—37 inches are still allowed to the yard; there are several pounds; apparently a stone may be 8 lb., 14 lb., or 16 lb.; a hundred may be a hundred, or a hundred and twelve, or a hundred and twenty (a great hundred) units; while we have also such things as "strikes," "bags," "boxes," etc., of very questionable contents. Such variations tend to promote that "opportunism" which is at daggers drawn with the wider and more humane view of commerce. The tendency to perpetuate this heterogeneity is not only British; it is international, and is undoubtedly one of the weaknesses which mankind as a whole must face and fight if larger opportunities for international service are to be won.

This inherent tendency explains why even among metric nations the metric system has not always conserved its pure form, and why among non-metric nations the metric system has not been introduced even into recently developed industries. Man has to fight against himself, or rather against certain of his intuitive tendencies, to become the controller of his own environment. Thus, when Mr. W. R. Ingalls, in his paper read before the Institution of Mining and Metallurgy on May 24, confesses to thinking more clearly in the pound than in the kilogram, the present writer is reminded of how for years his personal unit of weight was the 8-lb. to 9-lb. hare which he carried when accompanying certain of his relatives on their shooting expeditions. The suggestion undoubtedly is that the sooner we definitely teach our young people to work and think in carefully standardised units, instead of allowing them to adopt units accidentally coming within their cognisance, the better for us as a nation and for the world in the broadest sense. Have we yet realised the advantages of deliberate intent, as distinct from casual drift, in this and other similar problems which we must face?

We are now in the third stage, in which the objections to the denary scale and the metric units have practically disappeared. Thus the two problems which to-day are being seriously debated are:

(1) If the metric system is the only possible system that may be universally adopted, will the expense entailed in its adoption by non-metric countries be more than balanced by the advantages gained in the reasonably immediate future?

(2) If it is desirable to adopt wholeheartedly the metric system throughout our industries, how may this best be effected with reference to both our working staffs and the material means by which metric measurements may be made?

With reference to the first proposition, there is no need to discuss the possibility of the universal adoption of the British system rather than the metric system, for two reasons. The first is that there is no British system. Take the textile industries as an example. The Bradford manufacturer speaks a more difficult textile language to the Leeds manufacturer than the Continental manufacturer employing the metric system; and instances might be multiplied. Again, the most standardised of all the British systems—the avoirdupois—scarcely bears signs of its British origin on its face. The second reason is that year by year, month by month, and almost week by week, our industries are being more and more controlled from their laboratories—and all scientific laboratories adopt the metric system. What confusion and mistakes there will ultimately be unless uniformity is here enforced!

Looking at the problem from the broadest basis, Mr. Ingalls' paper is a delightfully unconscious portrayal of the typical British (or American) attitude of mind. We must make our drawings in our own units, and if the French want them they

must re-draw them. If Russia, China, and South America want British or American productions, they must buy them in our sizes. But surely we have attained a broader outlook than this? If not, the future for our industries is not of the brightest. Will Japan, for example, follow such a lead or take the broader view?

Granted, then, that the metric is now the only possible universal system, will it pay Britain and the United States to adopt it? The answer to this question entails the consideration, in the first place, of what the expenses are likely to be, and, in the second, of what return may reasonably be expected. In the paper already referred to, and particularly in an article on "The Metric System: Its Meaning for the Machine Shop," appearing in the *Times Engineering Supplement* of May 25, the expenditure that would be entailed in making the proposed change is advanced as the main and most potent reason against the proposal. This argument is exactly that which advocates for the change would expect and wish to answer. The question is now brought down, or rather elevated, to a practical issue which those who are for and those who are against must seriously face. Action must be taken one way or the other, and a decision on this particular, and possibly dominant, issue may readily be arrived at. Instead of the writer in question quoting only capital expenditure on gear cutters, drills and reamers, screwing tackle, measuring instruments, machine tools and gears, let him also supply a trading account—a yearly turnover account—based upon a standard plant on which the expenses of the proposed change may also be arrived at. Here is a simple one taken from the textile industries (a worsted drawing plant):—

	£
Total cost of installation	1,120
Annual depreciation allowance at 7½ per cent. per annum	84
Turnover of raw material	56,250

From this it must be evident that two of our greatest industries, cotton and wool, have much more serious questions to face than capital charges; and in these days, when we do not hesitate to spend 9,000,000*l.* a day on the war, there must be something more than a mere statement of expenses, however small or however great, if such an objection as that advanced by the writer in the *Times Engineering Supplement* is to be seriously considered. There must be a careful balancing up, with all the disadvantages and the advantages in full view. The writer can state, without hesitation from personal experience, that at least in certain of our industries not only would there be a prospect of recuperating from the inevitable expenditure within a reasonable limit of time, but also that from the day the metric system was adopted there would be a credit side to the account.

If, then, it be granted that it is desirable wholeheartedly to adopt the metric system, the practical means of carrying this into effect should immediately be thought out and the train laid and fired. Here is straight away a splendid use for our schools and colleges. The task that will be set them is one which, if their teaching staffs will rise to the occasion, will revitalise mathematical knowledge, introducing inspiration in the place of the too often orthodox deadness and stimulating both the teacher and pupil. The task of supplying the necessary weights and measures might well be left in the hands of those who would first instruct, and then organise into an active force, the more capable of our men returning from the front on the declaration of peace. What an opportunity for organising and carrying into effect a movement that would be a credit even to a nation which has so valiantly helped to withstand, at all too short a notice, the onslaught of the greatest military force the world has ever seen.

The alternative to the compulsory adoption of the metric system throughout our industries at once is its gradual introduction trade by trade; but of the alternatives we prefer the former. Already certain manufacturers are prepared to run their factories on the metric system, and are only deterred from so doing by the necessity of training every fresh hand that enters their establishment from non-metric factories. With this difficulty removed by suitable legislation, the advantage is most markedly on the side of the metric system. At least, this is the firm opinion of those who have worked under both systems in British and Continental workshops and factories.

A. F. B.

PROF. W. B. CLARKE.

THE death of William Bullock Clarke on July 27 deprived Maryland of one of its most distinguished men of science. He came of an old New England family, his ancestors having crossed in the "Mayflower." He was born in Vermont in 1860, and after taking a degree at Amhurst College studied at Munich from 1884–87, where he obtained the degree of Ph.D. He returned the same year to Baltimore to the post of geological instructor at Johns Hopkins University, and in 1894 became professor and head of the Department of Geology there. He used his vacations and spare time in working for the Geological Survey of the United States, on the regular staff of which he remained until 1907. Most of his work for the survey was on the Cretaceous and Kainozoic rocks of the coast district, and he helped in the geological survey of the country around Philadelphia and Trenton.

His most important single piece of research is probably his bulletin on the Mesozoic echinoids of the United States. He was, however, led from research by his skill as an organiser. In 1892 he founded the Maryland State Weather Service, of which he remained director until his death. In 1896 he established the Maryland Geological Survey and became State geologist. Under his direction the State Survey issued a series of geological reports which are notable both for their breadth of view and their unusually excellent form. As State geologist he was responsible for the Road Service, on which, before its separation

as an independent department, he was responsible for the expenditure of more than two million dollars. He was also entrusted with the representation of Maryland on the re-survey of the boundary between that State and Pennsylvania. He was executive officer of the Maryland Forestry Board, and took an active share in the replanning of Baltimore after the great fire in 1904. Meanwhile he had been continuously active in the development of the mineral resources of Maryland and in various spheres of educational and philanthropic work.

His death will be deplored in this country by many friends who knew the charm of his personality and by the still wider circle who knew of his success in scientific administration.

NOTES.

Two new orders have been instituted by the King in recognition of services rendered by British subjects and their Allies in connection with the war, viz. the Order of the British Empire and the Order of the Companions of Honour. The Order of the British Empire has five classes, viz.:—*Men*: (1) Knights Grand Cross (G.B.E.); (2) Knights Commanders (K.B.E.); (3) Commanders (C.B.E.); (4) Officers (O.B.E.); (5) Members (M.B.E.). *Women*: (1) Dames Grand Cross (G.B.E.); (2) Dames Commanders (D.B.E.); (3) Commanders (C.B.E.); (4) Officers (O.B.E.); (5) Members (M.B.E.). The first two classes, in the case of men, carry the honour of knighthood, and in the case of women the privilege of prefixing the title "Dame" to their names. The first lists of appointments to the orders have just been issued, and among those named we notice the following:—To the Order of the British Empire: Lord Moulton and Lord Sydenham (G.B.E.); Mr. Dugald Clerk, Prof. H. S. Jackson, and Mr. R. Threlfall (K.B.E.); Dr. Garrett Anderson, Prof. H. B. Baker, Mr. L. Bairstow, Prof. W. H. Bragg, Prof. S. J. Chapman, Mr. W. Duddell, Mr. F. W. Harbord, Prof. F. W. Keeble, Dr. Mary A. D. Scharlieb, and Prof. J. F. Thorpe (C.B.E.); Prof. J. C. McLennan (O.B.E.). The following have, among others, been appointed Companions of Honour: The Hon. E. Strutt and Prof. Ripper.

A COMMITTEE to inquire into various matters connected with the *personnel* and administration of the Army medical services has been appointed by the Secretary of State for War. The committee is composed of Major-General Sir F. Howard (chairman), Sir Rickman J. Godlee. Bart., Sir Frederick Taylor, Bart., Sir W. Watson-Cheyne, Bart., Dr. Norman Walker, Lieut.-Col. A. J. Stiles, Dr. Buttar, and Dr. J. B. Christopherson (secretary). It will begin its work in France, and afterwards carry out similar investigations in this country.

WE regret to see the announcement of the death, at the age of seventy years, of Major A. N. Leeds, the palæontologist, which occurred on Saturday last.

THE death is announced, at the age of seventy-three years, of Mr. Donald Maclennan, well known as a breeder of pedigree stock.

WE regret to record the death of Mr. Walter E. Archer, which occurred suddenly on August 19 at Sand, Norway, at the age of sixty-two. Mr. Archer was successively Inspector of Salmon Fisheries for Scotland (1892–98), Chief Inspector of Fisheries under the Board of Trade (1898–1903), and Assistant Secretary in charge of the Fisheries Department of the Board of Agriculture and Fisheries (1903–12). When in Scotland Mr. Archer, in association with Prof. Noel Paton, Mr. J. R. Tosh, and others, instituted a series of investigations on the salmon, which helped to elucidate a number of points which were still obscure in the life-history of that fish. In London Mr. Archer devoted great attention to the development of a more efficient system for the collection and subsequent study of the statistics of English sea fisheries, and the very valuable work in that direction now done by the Board of Agriculture and Fisheries is chiefly due to his initiative. He was for a number of years a British delegate to the International Council for the Investigation of the Sea, and president of that body from 1909 to 1912.

THE science staff at Christ's Hospital has again suffered severely from the war by the death on active service of Lieut.-Col. T. H. Boardman, who died of wounds on August 4. Col. Boardman joined the school when it was removed to Horsham in 1902, and was one of the four masters appointed to establish and develop a science department under the new conditions. His previous experience as science master at Blair Lodge, following a brilliant career at Bury Grammar School and at Peterhouse, Cambridge, was invaluable in the pioneer work of winning for science a footing in a public school of classical traditions. Adopting essentially the heuristic method, he proved himself to be a teacher of the highest order, with a power of control and organisation that contributed in no small degree to the success and popularity of the new department. Although he was co-editor with Mr. Wm. French in a school text-book on chemistry, physics was his special *forte*, and before he left to take up his commission as Major in the Royal Fusiliers on the outbreak of war, he had brought his laboratory to a high state of efficiency. Originality and thoroughness were stamped on everything he undertook, and many were the ingenious devices he invented for illustrating the principles of the various branches of physics dealt with. For many years he carried out with some of his classes an interesting scheme of agricultural experiments, the results of which he utilised as a basis for much useful work in the laboratory. "A hero and a gentleman," one of his officers writes of him, loved and respected by all who knew him, his willing sacrifice for King and country is a loss to the school immeasurable, and to his wide circle of friends a sorrow beyond expression.

THE death is announced, in his forty-sixth year, of Prof. Albert F. Ganz, holder of the chair of electrical engineering since 1902 at the Stevens Institute of Technology, Hoboken, N.J. Prof. Ganz had previously held the post of assistant professor of physics and applied electricity at the same institution. He had specialised in electric lighting and in the investigation of the corrosion of underground structures by electrolysis, on which subjects he had contributed largely to American technical journals.

DONATIONS and promises towards the Ramsay Memorial Fund received by the honorary treasurers amount so far to 21,352*l*., including 835*l*. from members of the British Science Guild; 500*l*. from Sir George Beilby, and 100*l*. each from Lord Rosebery, the Company of Clothworkers, and the Salt Union, Ltd. Prof. Orme Masson, of the University of Melbourne, has undertaken to act as the representative and corresponding member of the committee for Australia. As already announced, Prof. C. Baskerville, of the College of the City of New York, is acting in a similar capacity for the United States.

SEVERAL letters on the sound of gunfiring have appeared in the *Times* (August 22, 24, and 25), following the interesting letter by Mr. G. F. Sleggs, the greater

part of which was reprinted in our last issue (p. 513). The recent letters deal with the transmission of the sound-waves by the earth, though the inferences are not always correct, as, for instance, when it is argued that the sound must travel through the ground because it is heard more plainly when the wind is contrary. At Rusthall (near Tunbridge Wells), a gravedigger, who was digging a deep grave, stated that the sound of the firing at the bottom was much louder than on the surface. A lady, lying on the top of Blackdown Hill, in Sussex, heard the heavy bombardment of June 24, but, when sitting up, heard nothing. Another writer recalls an incident of the battle of Waterloo. Marshal Grouchy and several of his staff were at Sart-les-Walhain when an officer reported that firing was heard to the west. "Some of them placed their ears to the ground and thus detected plainly the muffled boom of distant guns."

AN account of a remarkable lightning display was given in the *Morning Post* of August 24, the occurrence happening between sunset and midnight of August 22. The phenomenon was witnessed in London. On the afternoon of August 22 heavy clouds had gathered, and these were dissipated by sundown, when the sky became clear, except that there was a narrow belt of cloud low down on the horizon from north-east through east to south. Near the belt of cloud on the horizon there were at short intervals what are described as vast bursts of flame thrown up into the atmosphere, and at times a flash of ramified, or zigzag, lightning would shoot up far above the cloud. The whole surrounding country seemed illuminated. The source of the flares appeared to be in the vicinity of the east and south-east coasts, and was erroneously attributed by many to war operations. No thunder accompanied the lightning, but thunder cannot be heard for more than ten miles, although lightning is visible ten times that distance and more. Recent weather has been very disturbed, frequent storm areas have traversed England, and thunderstorms have occurred very commonly in many parts of the country, accompanied by strong winds and rain.

REFERENCE was made in our issue of June 21 to the systematic collection of horse-chestnuts for war purposes. A scheme for such collection and utilisation for munition purposes has now been approved, and a circular upon the subject is being sent to local education authorities and secondary schools saying that the Board of Education has been requested by the Minister of Munitions and the Food Controller to bring the scheme to the notice of school authorities, governing bodies, and teachers, and to request their assistance in giving effect to it. It is felt that school children could give most valuable assistance in collecting the chestnuts, and by so doing make a definite contribution to national efficiency. It is suggested, therefore, that the governing bodies, managers, and teachers of schools should organise the efforts of the children for the purpose. To effect this a small committee might be formed in connection with each school or convenient group of schools to undertake the organising work in connection with the scheme in the district concerned, and to answer inquiries. It is understood that in many districts the scheme has already been taken up by private individuals, and it is obviously desirable that all persons undertaking work in connection with the scheme should co-operate with one another. A limited number of sacks and baskets are available for the collection of the nuts, and where there is any difficulty in obtaining bags or baskets locally application should be made to the Director of Propellant Supplies, Ministry of Munitions, 32 Old Queen Street, London, S.W.1. When the collection is complete the committee should inform the Director of Propellant Supplies, as above, stating the estimated quantity of the collection, and the Ministry of Munitions will arrange to remove the nuts and forward them to the factories in the course of the winter.

THE autumn meeting of the Institute of Metals will be held on Wednesday, September 19, in the rooms of the Chemical Society, Burlington House. The following communications are expected:—Experiments on the fatigue of brasses, Dr. B. P. Haigh; Hardness and hardening, Prof. T. Turner; The effects of heat at various temperatures on the rate of softening of cold-rolled aluminium sheet, Prof. H. C. H. Carpenter and L. Taverner; A comparison screen for brass, O. W. Ellis; Further notes on a high-temperature thermostat, J. L. Haughton and D. Hanson; Principles and methods of a new system of gas-firing, A. C. Ionides; Fuel economy in brass-melting furnaces, L. C. Harvey, with additional notes by H. J. Yates; The effect of great hydrostatic pressure on the physical properties of metals, Prof. Z. Jeffries; The use of chromic acid and hydrogen peroxide as an etching agent, S. W. Miller.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on September 20 and 21, when the following papers will be read:—"Present Practice in Briquetting of Iron Ores," G. Barrett and T. B. Rogerson; "Microstructure of Commercially Pure Iron between Ar_3 and Ar_2," W. J. Brooke and F. F. Hunting; "The Influence of Heat Treatment on the Electrical and Thermal Resistivity and Thermo-electric Potential of some Steels," E. D. Campbell and W. C. Dowd; "New Impact Testing Experiments," G. Charpy and A. Cornu-Thenard; "Heat Treatment of Grey Cast Iron" J. E. Hurst; "Effect of Mass on Heat Treatment," E. F. Law; "Investigation upon a Cast of Acid Open-hearth Steel," T. D. Morgans and F. Rogers; "The Acid Open-hearth Process," F. Rogers; "The Eggertz Test for Combined Carbon in Steel," J. H. Whiteley; "Failure of Boiler Plates in Service and Investigation of Stresses occurring in Riveted Joints," E. B. Wolff.

THE University of Pennsylvania has issued as vol. vii., No. 1, of the series of anthropological publications an account of the excavation of the cemetery of Pachyamnos, Crete, by Mr. R. B. Seager. This place lies on the isthmus of Hierapetra, in the eastern part of the island, and apparently owed its importance to the use of the isthmus as a trade route. The cemetery was accidentally disclosed after a torrential rainstorm in October, 1913. It seems to have continued in use from very early times down to the Late Minoan period. A notable feature in the interments is the utter disregard shown by the Minoans to the graves of their ancestors, the older graves being constantly disturbed by later burials. The corpse usually lies in the jar in a sitting position; there is evidence to show that the body was deposited in the jar with the head downwards, and the jar was then fixed in the ground bottom up, so that it occupied a sitting or crouching position. The jars are usually of small dimensions, and in some cases it would seem that the hip- and collar-bones were broken in order to force the body into the jar; in other cases it is suspected that the bodies were trussed up immediately after death, or even before death had actually taken place. The lack of reverence for the dead is also shown by the fact that the best jars were not given for use in burial, and if a household happened to possess a damaged specimen it was considered good enough to serve as a coffin.

MANY investigations have been made during the last few years on the nature of the microbe of typhus fever. Several bacterial organisms have been isolated in the disease, notably one by Plotz in America a year or two ago, but none has been satisfactorily proved to be the causative organism. It is now announced that Prof. Kenzo Futaki, of Tokio, has discovered the presence of a spirochæta, a protozoon organism, both in the kidney of patients dead of the disease and in monkeys artificially infected with the disease.

THE tenth report on plague investigations in India has been issued by the advisory committee as Plague Supplement v. of the *Journal of Hygiene* (vol. xv.). It contains epidemiological observations on plague in the United Provinces of Agra and Oudh during 1911–12 by Majors Gloster and White, I.M.S. They find that an association of unusual humidity during the winter months in certain districts with severe epidemics of plague is so constant a phenomenon that they feel justified in concluding that one stands to the other as cause to effect. They believe that this relationship is due to the effect of humidity in prolonging the life of rat fleas when separated from their host. Dr. St. John Brooks in another paper finds that plague does not maintain itself in epidemic form when the temperature rises above 80° F. accompanied by a saturation deficiency of more than 0·30 in.

WE have received a letter from Mr. S. Mahdihassan, of Bangalore, commenting on Dr. Hankin's letter on "Ten per cent. Agar-Agar Jelly" which appeared in the issue of NATURE for March 8 last. Mr. Mahdihassan has found exceptional difficulty in sectioning chitinous tissues at the high temperature of the plains of India by the paraffin or any other method, and considers Dr. Hankin's method will prove a boon. He is not clear why large wings of insects should be embedded in agar when celluloid is to be preferred for smaller wings. Presumably small wings *can* be embedded in celluloid, whereas larger wings cannot, hence the value of the agar-agar jelly method for the latter.

IN the *British Medical Journal* for July 28, Sir Patrick Manson gives an admirable summary relating to British contributions to tropical medicine dealing with protozoa, helminths, and beri-beri. In the same number Major McCarrison, I.M.S., details Indian contributions to the advancement of medicine. A somewhat similar summary dealing with the scientific and administrative achievements of the Medical Corps of the United States Army, by Lieut.-Col. McCulloch, appears in the *Scientific Monthly* for May. All these papers give useful surveys of progress in the departments of medicine with which they deal.

IN a paper on "The Probable Error of a Mendelian Class-Frequency" (*American Naturalist*, vol. li., 1917, pp. 144–56), Dr. Raymond Pearl presents a method of calculating and expressing the errors, due to random sampling, of a Mendelian class-frequency. The method consists essentially in expressing each *expected* Mendelian class-frequency as the probable quartile limit for that class-frequency in a supposed second sample of the same size as the observed sample drawn from the same population. These quartile limits are determined from the ordinates of a hypergeometric series. Various simplifications of method are suggested and illustrated, and the method is put forward as a supplement to, not as a substitute for, the "chi-squared" test for the goodness of fit in Mendelian distributions.

THE *American Museum Journal* for May contains an extremely interesting account, by the late Mr. Joseph H. Choate, of the origin and development of the great Natural History Museum of New York, which depended in its early days entirely on the munificence of the more wealthy of its trustees. When it became apparent that it would be quite impossible to build up by private means alone a museum worthy to compete with the museums of Europe, it was decided to appeal to the Legislature for assistance. Immediately a site of eighteen acres in Manhattan Square was granted, and on this the present building was erected. It was opened in 1877. From this date it grew with incredible speed to occupy the position of one of the world's greatest museums. To this number also Col. Theodore Roosevelt contributes some brief but most valuable notes on the loggerhead and green turtles, which, it seems, are commonly attacked and eaten by sharks in the waters of Florida, while Dr. Clyde Fisher contributes a short account of the methods employed in the capture of the "gopher tortoise" in Florida, where it is eaten in large numbers.

DR. COLIN MACKENZIE, in the *Journal of Anatomy* (vol. li., part 3), records the results of his studies on the peritoneum and intestinal tract in Monotremes and Marsupials. His researches have failed to discover in any of the mammalia up to the great Anthropoids the presence of the so-called Jackson's membrane, Lane's band, or Treitz's band, and he therefore concludes that these must be regarded in man as adaptations to the erect posture. He also suggests a revision of the nomenclature now employed in describing the various regions of the human colon. His use of the terms "acquired" and "biological" instead of "adaptive" and "ancestral" is, to say the least, curious.

THE report of the Education Branch of the Board of Agriculture and Fisheries for the year 1915–16 is published in the July issue of the *Journal of the Board of Agriculture*, with a note that owing to conditions due to the war the customary separate issue is suspended. The report affords gratifying evidence that, despite the severe restrictions imposed by the war upon the development of agricultural education and research, much useful work was accomplished during the year under review. It is not surprising to find a great decrease in the numbers of students taking long courses of instruction, whereas the numbers taking short courses were more than maintained. One notes with regret the necessity for the closing of the Royal Agricultural College, Cirencester, and the Agricultural College, Uckfield, Sussex, and the withdrawal of grants from two other institutions as a measure of war economy. Research work suffered severely owing to the heavy drain upon the staffs for Army or munition purposes, but much useful work on problems of immediate technical importance was accomplished, of which the investigations at Cambridge on wheat-breeding and at Rothamsted on soil and manurial problems may be singled out for special mention.

THE volume dealing with the area, crops, live stock, land revenue, assessment, and transfers of land in British India during 1914–15 has been published by the Department of Statistics, India, under the title of "Agricultural Statistics of India," vol. i., price 4s. The area treated embraces nearly a million and a quarter square miles, including feudatory States under the control of local governments. Of the total area about 37 per cent. was under crops during the year, and full details of the acreage of each crop is given, both for the provinces and every district. This valuable statistical volume is enhanced by two appendices, the first giving the vernacular names of the crops, and the second being an alphabetical list of crops, with their scientific nomenclature.

A VALUABLE paper on oil shales and torbanites, by Mr. H. R. J. Conacher, appears in the Transactions of the Geological Society of Glasgow (vol. xvi., part ii., pp. 164–92). These bodies form a group of materials

characterised by yielding valuable commercial paraffin oils in distillation, and are, at the present moment, of very considerable importance. Torbanehill mineral, or "boghead coal," has been exhausted for some years, and for oil production the shales of Lothian, Fife, and Linlithgow are relied on. The author deals with the megascopic, but more particularly the microscopic, study, together with a rough comparison of the oil yield and its character. Previous work has led to much difference of opinion as to the constitution and origin of the torbanite and oil shales. Micro-constituents are very varied; they include minute carbonised fragments of plants; yellow bodies, regarded variously as remains of algæ, vegetable spores, or as residues from oil globules; shells of minute crustaceans, teeth and scales of fishes; and a high proportion of mineral matter, parts believed to be pyrites crystals. Boghead coal consists of little beyond the yellow bodies, which, the author concludes, on very good reasoning, are metamorphosed resins, and these yield the characteristic oil products. Interstices are filled with opaque, amorphous matter, similar to that forming the ground mass of coal, and yield products similar to coal-tars, and from this portion the important nitrogenous constituents in shale products are derived. Unhesitatingly the author ascribes these shales and torbanites to vegetable sources. The boghead coal of Linlithgow represents a deposit formed in a swamp fringed with vegetation, but with open water towards the centre sufficiently deep to prohibit the growth of plants. Drifted vegetable matter reaching the central area became so completely oxidised as to leave practically only the resin. The Lothian oil shales accumulated as the widespread mud-flats of an estuary, the river bringing down a proportion of extremely macerated vegetable matter, the ebb and flow of the tide aiding in the elimination of the woody materials and concentration of the resin.

THE Italian Geographical Society continues its series of special publications on the Italian field of operations and the borderlands of Italy. A small volume ("Pagine Geografiche della nostra Guerra") contains six lectures delivered before the society in 1916 on the geography of the war area, the geology of the Trentino, the Adriatic lands of Albania, the Carso, Dalmatia, and the Carnic Alps. The volume is illustrated with several black-and-white maps and one coloured one, which is specially interesting. It is a map of the regions adjoining the present political frontier of Italy in the north-east, and is coloured to show the distribution of races as represented by majorities or minorities of Slavs, Italians, and Germans. The proposed new frontier drawn on this basis shows a close coincidence with the natural physical frontier running along the Alps.

IN the *Scientific American* for July 21 Prof. T. H. Norton describes in simple terms the problems in dye synthesis which are now being undertaken by American chemists. He traces the evolution of synthetic dyes from some seven or eight direct coal-tar products ("coal-tar crudes") through the intricate maze of intermediate products to the finished dyewares. The processes whereby the coal-tar crudes are converted into intermediates are the chemical operations of nitration, reduction, sulphonation, alkali fusion, chlorination, oxidation, and sulphur fusions. These processes, constituting the simpler reactions where inorganic reagents are employed, are now carried out on a very large scale and require highly specialised plant, of which illustrations are given. As a concrete example, the care of the important colour-producing intermediate, "H. acid," is cited. This substance, which has the systematic name of 8-amino-α-naphthol-3 : 6-disulphonic acid to distinguish it from 219 isomerides, is derived from naphthalene. The hydrocarbon is treated with sulphuric acid (sulphonation) and converted into naphthalene-2 : 7-disulphonic acid, one of ten possible isomerides. The product is treated with nitric acid (nitration), when 1 : 8-dinitronaphthalene-2 : 7-disulphonic acid is obtained. The dinitro-compound is reduced with acid and iron filings to 1 : 8-diaminonaphthalene-2 : 7-disulphonic acid, the penultimate intermediate which on heating with dilute sulphuric acid under pressure at 120° C. yields the required H. acid. This highly prized intermediate is greatly needed in the preparation of direct cotton blues and various shades of black, violet, and green. The preliminary work to be done in passing from naphthalene to this intermediate may be gauged by the fact that the raw material costs about 5*d*. per lb., whereas H. acid is quoted nowadays at about 10*s*. per lb.

WE have received a copy of a pamphlet by Mr. Robert N. Tweedy on "Industrial Alcohol," written for, and published by, the Dublin Co-operative Reference Library. Its object is mainly twofold: first, to emphasise the desirability of producing a home-grown liquid fuel, and secondly, to do so to the advantage of agriculture. These two objects are to be fulfilled by the manufacture of potato spirit on a large scale. The author points out that our staple fuel, coal, cannot be used for a variety of industrial purposes, such as the manufacture of chemicals and motor traffic, and that for the latter especially we are dependent on imported petroleum, which is steadily rising in price. In 1914 we imported petrol to the extent of 120 million gallons (imperial), in addition to 150 million gallons of burning oil. The extent to which alcohol is used on the Continent, especially in Germany, for industrial purposes may be judged from the following statistics. Whereas in 1914 a little more than four million gallons of methylated spirit were used in the United Kingdom, in 1912 France produced 87½ million gallons, of which eighteen million gallons were denatured and twelve and a half million gallons were used for heating and lighting. In 1913 Germany produced seventy million gallons from potatoes alone, representing 80 per cent. of the whole production of alcohol, a large proportion of which was used for heating, lighting, and motor traffic. The author lays stress on the fact that denatured alcohol for industrial purposes might be produced with profit from potatoes in the manner that has been developed with so much success in Germany; but that to do this an entire revision of the excise laws will have to be taken in hand. At present it is hedged in with such restrictions that until they are removed or modified there is no prospect of this important branch of agriculture being seriously exploited.

A WRITER in *La Nature* for August 4 discusses the special features which aeroplanes of the chaser and bombardment types should possess for adequately carrying out the work assigned to them. He takes as examples of the two classes the Gotha type—*i.e.* the type which has been prominent in recent air raids over London—and the Albatros. The Gotha type is characterised by extensive plane area, high engine capacity, and its powerful armament. The latest types carry 600 kilos. of bombs. The power necessary is furnished by two motors of 260–280 h.p. each. The planes cover an area of about 100 sq. metres, while the total length of the aeroplane is 12 metres and the span 24 metres. A speed of 140 kilometres per hour can be attained. The Albatros of the D.I. type has a Mercédès engine of 170 h.p., a plane area of about 24 sq. metres, a length of 7 metres, and a span of 9 metres. It has a speed of 200 kilometres an hour. Further interesting details of the construction of these two types of aeroplane are given in the article quoted.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following is a continuation of Messrs. Crawfurd and Alter's ephemeris of this comet, for Greenwich midnight:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
Aug. 31	23 40 22	+12 24 23	9·9998	
Sept. 2	40 22	11 34 5	0·0020	2·29
4	40 18	10 43 12	0·0045	
6	40 12	9 51 55	0·0074	2·17
8	40 4	9 0 25	0·0108	
10	39 53	8 8 54	0·0146	2·05
12	39 42	7 17 34	0·0188	
14	39 29	6 26 35	0·0234	1·91
16	39 16	5 36 9	0·0284	
18	39 4	4 46 27	0·0338	1·77
20	38 52	3 57 38	0·0396	
22	38 41	3 9 52	0·0457	1·63
24	38 31	2 23 17	0·0522	
26	38 24	1 38 1	0·0590	1·49
28	38 18	0 54 11	0·0661	
30	38 15	0 11 50	0·0735	1·35

The unit of brightness is that on April 21, 1917. The comet will be at opposition on September 17.

RADIAL VELOCITIES OF SPIRAL NEBULÆ.—In view of the faintness of spiral nebulæ, and the small dispersion necessarily employed in photographing their spectra, some doubt may have been felt as to the reality of the extraordinarily high radial velocities which have been derived for these objects. A recent statement by Dr. V. M. Slipher, however, appears to place the main results beyond question (the *Observatory*, August). The average velocity which he has found for thirty spirals is 570 km. per second, and he points out that this is more than twenty-five times the velocity of an average star. Thus, although the spectrograph employed for nebulæ at the Lowell Observatory has a linear scale only about one-fifteenth that of a powerful three- or four-prism spectrograph, it is at no disadvantage as regards the relative accuracy of the results obtainable in the two cases, when similar precautions have been taken. Further confidence is given by the agreement in the results obtained for the Great Andromeda nebula at four different observatories, namely, velocities of approach of 300, 304, 300–400, and 329 km. per second. These compare very favourably with the values which have been found for stellar velocities by different observers, those for Canopus, for example, ranging from 18·5 to 21·0 km. per second.

THE HISTORY OF ORBIT DEDUCTION.—In an address on "The Derivation of Orbits: Theory and Practice," delivered to the American Mathematical and Astronomical Societies, and published in *Science* of June 8, Prof. A. O. Leuschner deals in an interesting and illuminative manner with the history of orbit deduction from Newton downwards. Prof. Leuschner himself introduced some very useful modifications a few years ago, and his method is now generally acknowledged to be the most rapid and convenient for obtaining preliminary orbits of newly discovered planets or comets. It is based on that of Laplace, using three observed right ascensions and declinations, and their first and second differences. This method fell into discredit owing to some over-hasty strictures of Lagrange; it had the undoubted disadvantage that the first and third observed positions were not exactly satisfied by the resulting orbit. Harzer showed how differential corrections might be applied, and Leuschner introduced further improvements, which are best summarised in his own words. "Criteria have been introduced . . . regarding the eccentricity. Provision has been made for passing from parabola to ellipse without repeating the solution. Numerical criteria have been set up to distinguish the physical from the mathematical solutions. A method has been provided for eliminating the parallax. The various approximations for the distances are avoided; these are taken from a table; the accuracy attainable in each case can be ascertained, and the range of solution determined." These claims are well justified in the numerous orbits that have been published by Prof. Leuschner and his students. The case of planet MT (Albert) was particularly striking. Dr. Haynes obtained an orbit from three observations, at very short intervals, by the aid of which several other places were found on later plates; they were so faint that an approximate knowledge of the position was required before they were detected.

PROGRESS OF APPLIED CHEMISTRY.

THE annual general meeting of the Society of Chemical Industry was held in Birmingham on July 18–20. At the opening meeting the chair was taken by the Lord Mayor of Birmingham, Ald. A. D. Brooks, who, in an address, said the society had two chief objects at present: first, to assist in the prosecution of the war, and, secondly, to do its best to help the country after the war. The war was being carried on largely by scientific methods, and the chemist was devoting his attention chiefly to destroying human life, whereas formerly his efforts had been directed to the elimination of things dangerous to life. Before the war Englishmen had allowed important improvements to pass into other hands, but they must see to it that this did not happen again. Suspended industries must be rebuilt, and all conducted on sound economical lines, using to the full all scientific and technical help. Alluding to Birmingham industries, the Lord Mayor emphasised the need for recovery of waste products and conserving mineral resources.

Dr. Carpenter replied suitably, and proceeded to read his presidential address. He indicated the basis of modern industry in the sciences of mechanics and chemistry, and insisted on the absolute necessity for the engineer and the chemist to "get into double harness as quickly as possible" and work sympathetically together for the progress of the chemical industry.

Each paper given during the congress might be cited as an exemplar of the president's remarks. Each was a record of an effort or efforts of the chemist to co-operate with the engineer, and in this way to further the interests of some industry. For example, Messrs. Hancock and King, in their paper on "The Texture of Fireclays," described methods of comparing the unfired fireclay with the finished material, and the paper by Mr. Henry Watkin on chemical porcelain was a record of many persistent attempts to convert the various clays found in different parts of the world into the finished materials satisfying many practical requirements. The latest and, according to Mr. Watkin, a completely successful attempt has been made in this country since the outbreak of war to produce in England a chemical procelain similar to that which was monopolised by Germany before the war.

Prof. Boswell instanced the fact that the war had greatly increased the output of glass and all kinds of metals and alloys, and he gave a record of work directed to the furnishing of British sand for the glass and metallurgical industries. Here the preliminary analytical work, which is of fundamental importance, forms a basis for all the far-reaching consequences which will follow for these industries in this country.

No finer example could be given than that of the modern gas industry illustrating the joint and successful co-operation of the chemist and the engineer, and the paper given by Mr. E. W. Smith, emphasising the merits of gas as an industrial fuel as against coal, etc., and that by Mr. C. M. Walter, exemplifying the

use of gas in such operations as metal melting, annealing, hardening, etc., indicated the rapid progress made in recent years in the chemistry and the mechanics of this industry.

Perhaps no development of chemistry is fraught with greater consequences to mankind than the "Fixation of the Nitrogen of the Air." The success of rival processes designed to accomplish this result must in times of peace be determined mainly by practical considerations *e.g.* cost, etc. The rival methods at the present time are the direct method of oxidation of the nitrogen to nitric acid, and the production of ammonia by the combination of nitrogen and hydrogen. Various means of bringing about direct oxidation of nitrogen were shown by Mr. Kilburn Scott, including the Kilburn Scott furnace. Mr. Scott's furnace is intended to increase the efficiency of the process by bringing the whole of the air under the action of the electric spark.

Dr. Edward B. Maxted, in describing the synthesis of ammonia, showed how enormously important the very latest refinements of chemistry and physics are, in this very complicated process, for practical success. The nitrogen is actually separated from the air in the first case by passing through a column cooled by liquid nitrogen, the oxygen being liquefied and the nitrogen passing forward, whilst the residual mixture of oxygen and nitrogen undergoes fractionation in the lower part of the apparatus. The hydrogen is produced by the interaction of carbon monoxide from water-gas with steam, and many refinements and devices are needed to get pure hydrogen free from carbon monoxide at a workable cost.

The actual combination of the nitrogen and the hydrogen is brought about by catalysts consisting of various metals or combinations of metals. Here, again, a whole series of complications ensue from which the chemist has to make his choice, and iron containing traces of other bodies as promoters is preferred as catalyst. The reaction is carried out at pressures of 150-200 atmospheres and at temperatures approaching a red-heat, followed by cooling out of the combined product from the residual nitrogen and hydrogen.

Under such conditions the ammonia vapour is exceedingly corrosive, and presents a problem of considerable difficulty to the chemist and to the manufacturer; and, indeed, at every stage of this long process the problems to be solved by the joint ingenuity of the chemist and the engineer, and the manner in which they have been successfully solved, are astonishing. Finally, the ammonia is fixed as ammonium nitrate, or more usually as ammonium sulphate, as this can be more easily handled.

The sewage problem is of world-wide importance, and the stereotyped methods in vogue amongst engineers during the latter half of last century proved quite unequal to its proper solution. Since the chemist came to the rescue conditions have greatly improved, and great progress has been made towards a satisfactory solution. The activated sludge process described by Mr. Ardern illustrates very forcibly that a proper understanding of biological chemistry is essential to the correct solution of this problem, and that the engineer must accommodate his plant and his operations to the conditions established for him by the chemist and biologist.

The alleged value possessed by sewage sludge has long been a lure to engineers and others, and Mr. Ardern and his colleagues have demonstrated that activated sludge possesses considerable manurial properties. This question is a relative one, however, and the activities of the chemist in producing cheap fixed nitrogen will profoundly influence the engineering and commercial aspects of the sludge problem.

The overwhelming need in industry for research, and yet more research, was emphasised by almost every speaker, and in a notable speech dealing with this question Dr. C. A. Keane indicated that not in one way, but in many various ways, could science best be made to serve the needs of industry by means of research.

Twenty-five papers were read during the congress.

F. R. O'SHAUGHNESSY.

TECHNICAL EDUCATION IN SOUTH WALES.[1]

PRINCIPAL E. H. GRIFFITHS has published three lectures which important representatives of commerce and education in South Wales were invited to attend. The first two set out very clearly and at considerable length views in regard to the dependence of industry on science and with reference to science as an essential element in education; with these views the readers of NATURE are well acquainted and, for the most part, in cordial accord. In the third lecture the author deals with the existing provision for scientific and technological education in his district and with the lack of proper co-ordination.

In regard to the relations between the University of Wales and its constituent colleges, Principal Griffiths appeals for wider discretion for the colleges, either as parts of the existing federal University, or, if this be found impossible, as separate entities. He refers favourably to the inclusion of the Swansea Technical College in the reformed University, and there can be little doubt that this is desirable. Effective co-ordination of technological work between Cardiff and Swansea would be for the good of both; the former city should be willing to give up some branch of technology to Swansea, so that for advanced study in that branch Cardiff should send its students to Swansea, while the rest of the advanced work should be concentrated at Cardiff. Work up to the standard of the intermediate examinations for the B.Sc. degree might, of course, be taken in both towns.

In England, also, we have suffered from lack of co-ordination of this kind. Really advanced work needs very large expenditure on teachers, apparatus, and material; to duplicate it unnecessarily means a number of weak departments instead of one strong one. It would be well if the English provincial universities should come to some concordat such as is advocated for Cardiff and Swansea.

Allusion is made to the young and thriving School of Mines already attached to the Cardiff University College. The coalowners of the Principality have readily taxed themselves to provide this institution; it is fortunately free from excessive academic control, and can, therefore, render more readily useful service to the greatest industry of South Wales.

There are in the district flourishing technical institutions at Cardiff and Newport, and Principal Griffiths would like to see these take their proper places in a general scheme. One difficulty in carrying into effect all such proposals is that local education authorities are not always willing to take a broad view of what they can most effectively do. Many of them want to provide every kind of technical education within the walls of the institution which they control; but some of them are by no means equally ready to provide the very large funds needed to do this with real efficiency. So we find too often quantity preferred to quality; for only the wiser authorities seem to realise that ten highly trained technologists will be of far more value to an industry and to the State than a hundred persons with but a smattering of knowledge.

J. WERTHEIMER.

[1] "Industry, Science, and Education." By Principal E. H. Griffiths. Pp. 70. (Cardiff: Roberts and Co., 1917.) Price 1s.

THE TREATMENT OF WAR WOUNDS.[1]

II.

Treatment of Wound Infections.

If you have now quite clearly apprehended the significant distinction between a live space and a dead space, you will with that have mastered the first great principle governing the treatment of all local bacterial infections. If you are dealing with infection in live spaces you can often mend matters by bringing (that is the rationale of hot fomentations) a larger blood supply—that means more lymph and more leucocytes—to the focus of infection; and again you can often mend matters by improving the quality of the lymph—that is the rationale of vaccine therapy; or again, you may apply both these procedures concurrently. But when you are dealing with an infected dead space you cannot in these ways mend matters. You might just as well take a test-tubeful of infected fluid and try by these means to influence it. Where you have infected dead spaces your remedial agent is the knife. You have to evacuate your dead space as I empty this test-tube.

Now that is the whole purpose and meaning of the surgery of the wound as carried out at the front. That can be summed up in two propositions. Every infected dead space must be cut down upon and evacuated. And, as a prophylactic measure, every space which would, if left to itself, become an infected dead space—that means every space occupied by an infected projectile or pieces of infected clothing or infected foreign bodies or devitalised infected tissues—must likewise be laid open and cleaned out. That exhausts the treatment of buried infections.

But it is only the beginning of the treatment of the wound. There is still the surface infection. The situation you have to face is just the same as that produced by emptying an infected tube; you have got rid of the infected contents, you have left the infection on the walls.

I now turn to the problem as to how best to deal with this infection. And here again inevitably we must establish distinctions. We must distinguish between the *naked tissue surface* made by the act of the projectile, or section with a knife, and the *granulating defensive surface*, which after a time clothes the naked tissues. In the former we have a non-vascularised surface, and in this a system of lymph spaces left without mechanical or biological protection other than that furnished by the emigration of leucocytes and (until that stanches) by the outflow of lymph. And the naked-tissue surface is not only ill-defended against microbic attack, it is also peculiarly liable to damage and to physiological deterioration of the kind which opens the door wider to such attack. Such a surface readily dries up; and drying means the closing down of the capillary circulation. Again, a naked-tissue surface, seeing that it is non-vascularised, readily takes cold, and by that both lymph outflow and emigration are arrested. And, lastly, a naked-tissue surface, if kept wet, will, so soon as the discharges become tryptic, readily undergo erosive digestion. Against all these forms of physiological degeneration special provision should always be made.

A granulating surface offers much greater protection against microbic infection, and is much less subject to damage. The tissues are covered in by many layers of protective cells, the lymph spaces are sealed over, and there has been laid down immediately below the surface in newly formed vessels a very abundant blood supply. All this is protection against massive microbic invasion from the surface, against the wound taking cold, and against erosive digestion. In short, there is with an infected granulating surface much less danger of a set-back than with an infected naked-tissue surface.

The Natural History of the Wound with a Naked-tissue Surface Left to Itself.

Let us consider the natural history of the untreated wound with an infected naked-tissue surface. I will take the case of an open shell wound left without treatment. According as it is wet or dry the evolution of this wound will be entirely different. Let us suppose that it is allowed to dry. Under the original dry dressing the blood and lymph flow from the surface will gradually stanch, and we shall then have a naked-tissue surface with a coating of coagulated blood and lymph. In this will be incorporated elements of moribund tissue, other elements of foreign matter, and always a certain number of microbes. Little by little the coating of coagulated blood and lymph upon the surface of the original wound, or of the surgeon's incisions, will dry up, and by that the capillary circulation will be closed down. And all the while the serophytic microbes will be proliferating. As a result of all this the superficial tissues will die and become gangrenous, and the originally clean naked-tissue surface will gradually be transformed into a dry, greenish-black, excessively fœtid, slough-covered surface pullulating with microbic growth.[2] Under the sloughs will then be formed infected dead spaces, and from these the infection—I am here thinking in particular of a gangrene infection—will invade the neighbouring live spaces, converting these in their turn into dead spaces until we have to cope with large areas of gangrene and a general intoxication.

That, of course, will happen only with very heavy infection or extreme physiological deterioration. With lighter infection or less adverse physiological conditions the invaded organism will have recourse to measures of defence. Gradually the superficial sloughs and gangrenous portions of the deeper tissues will be demarcated and then amputated from the living tissues—the amputating agent being, no doubt, the tryptic ferment in the dead spaces. And at the same time there will have been organised in the living tissues some little way back a defensive front built up on the same plan as a granulating surface.

Let me now tell you also what will happen if the infected surface is simply kept wet. Here, also, the microbes which have been incorporated in the clot would grow out. Then there would supervene leucocytic emigration, and upon that would follow a breaking down of the leucocytes with a setting free of trypsin; and after that any and every microbe would pullulate in the cavity of the wound and on the devitalised wound-surface. Finally, if treatment were still deferred there would be reproduced in an aggravated form (for there would in the open wound be a varied and more formidable infection) the evil train of events which is associated with infection in a buried dead space. When you reflect that an open wound cavity filled with tryptic pus is physiologically equivalent to an unopened abscess sac, you will see that erosive action will enlarge and deepen its cavity; that this will enable the microbic infection to burrow everywhere deeper into the walls; and that bacterial poisons will be absorbed.

All I have been saying in the last few minutes can be

[1] By Sir Almroth E. Wright, C.B., F.R.S. In its original form this lecture was delivered at the Royal Institution on March 9. It was supplemented by additional matter relating to antiseptics and the method of Carrel, and was printed in full in the *Lancet* of June 23. Parts of the lecture of purely technical interest have been omitted. Continued from p. 518.

[2] Let us note in connection with this that the albuminous substances of our tissues, when no longer bathed in lymph, are immediately degraded to the rank of unprotected native albumens.

compressed into this:—An infected naked-tissue surface becomes, if allowed to dry, *a desiccated slough-covered wound*; if simply kept wet, *a tryptic suppurating wound*. And the bacteriological events can also be expressed in a single sentence. A comparatively light infection, such as we have in the man whose wounds have been properly opened up and mechanically cleaned, is converted into a very heavy infection; and a purely surface infection into an infection invading the deeper tissues.

Problem of Preventing the Degeneration of the Wound when Treatment is Interrupted during Transport.

Having realised what happens to the wound when untreated, we have to think out how to keep wounds—whether originally completely open or opened by a surgeon—from falling during protracted journeys from hospital to hospital into these desperately unwholesome conditions. We have also to consider how to restore, as rapidly as possible, wounds which have lapsed into distressing conditions either through lying out untreated on the field or through interruption of treatment during lengthy transport.

Suggestion that the wound could be sterilised at the outset, and could be kept sterile by leaving an antiseptic in the wound.—The first thought of every man would probably be that the wound should be most carefully disinfected at the outset. But what happens in burns shows that to start in open wounds with a sterile surface avails nothing. A burn is at the outset absolutely sterile, and quite notoriously—no doubt the germs begin to arrive before the burnt surface has well cooled off—it tends to become very rapidly intractably septic. We may take it that the emigrating leucocytes are held back in the superficial sloughs, disintegrate there, and corrupt the exuding lymph. And this cannot be prevented by any application of antiseptics. It is just the same with war wounds. These become heavily infected even when they are drenched at the outset with the strongest antiseptics, such as undiluted carbolic acid and concentrated solutions of iodine.

This is not the place for any lengthy discussion of the reasons for this failure of antiseptics. But the gist of the matter can be put quite shortly. The current belief in the therapeutic efficacy of antiseptics rests on experiments which are quite fallacious. They are fallacious in that the antiseptic in those experiments was applied in watery media—media which left that antiseptic unaffected. To have value—that is, to have application to conditions obtaining *in vivo*—the experiments should have been conducted in pus or serum—media which quench antiseptic action. Again, in the experiments of the past the antiseptics were intimately mixed with the bacterial suspensions; whereas, applied in the wound, the antiseptic comes only into external contact with the infected wall and the inflowing discharges. Employed thus we cannot expect it to diffuse into and exert a bactericidal effect either in the infected wall or in the discharges.

By reason of these considerations having been disregarded, the issue as to whether antiseptics applied in the wound with prophylactic intent can be of any use must be investigated *de novo*.

Experimental Investigation of the Efficacy of Antiseptics.

Let me now try to indicate to you what sort of experiments should be undertaken before nourishing in connection with a particular antiseptic the expectation that it is going to be efficacious for sterilising and afterwards suppressing microbic growth in wounds. I can illustrate my points best if you let me show you here four tubes.

In tube No. 1 I have a suspension of microbes in water. I now add an equal volume of the antiseptic I wish to test and shake up thoroughly. These are, as you see, conditions which give every possible advantage to the antiseptic. It is applied in a non-albuminous medium and is intimately mixed with the microbes. To find out whether the microbes have been killed I draw off a sample and dilute with very many times its volume of nutrient medium. I then incubate to see whether I get any bacterial growth.

In tube 2 I make the conditions more favourable to the survival of the microbes—infinitely more favourable than if I left behind an antiseptic in a wound. I have here a mixture of staphylococci, streptococci, and gas-gangrene bacilli suspended in serum, and I now, as in tube 1, add an equal bulk of the antiseptic and shake up, and I then, following the technique of Prof. Beattie, pour on a little hot vaseline which will afterwards congeal. This, forming an air-tight seal, will allow the gangrene bacillus, if it survives, to grow out. It will also announce the growth of this microbe, for it will confine any gas which may be evolved from the culture.

Tube 3 is, as you see (Fig. 10), a tube which has

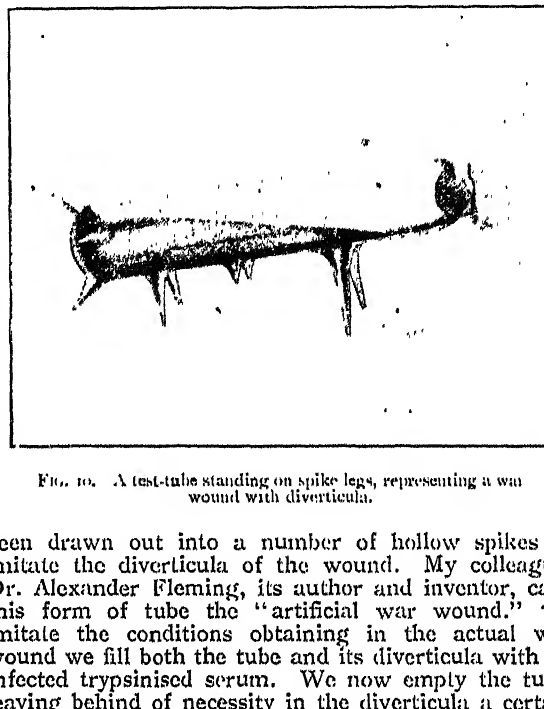


FIG. 10. A test-tube standing on spike legs, representing a war wound with diverticula.

been drawn out into a number of hollow spikes to imitate the diverticula of the wound. My colleague, Dr. Alexander Fleming, its author and inventor, calls this form of tube the "artificial war wound." To imitate the conditions obtaining in the actual war wound we fill both the tube and its diverticula with an infected trypsinised serum. We now empty the tube, leaving behind of necessity in the diverticula a certain amount of the original infected fluid. We then fill with an antiseptic; and the future of the infection will now depend on the penetrating power of the antiseptic. If the antiseptic penetrates into the infected fluid sterilisation will be obtained; if it fails to penetrate, microbes will survive. To test our result we empty out the antiseptic, refill with trypsinised serum, and incubate.

After asking in tube 3 whether the antiseptic can completely sterilise a wound which has its recesses filled with an infected albuminous fluid, I go on in tube 4 to investigate the question as to how far the antiseptic can penetrate into the walls of the wound. Tube 4 is, as you see, a tube with hollow spikes. I have coated the inside with infected serum agar, and the spikes provide in their hollows a greater depth of

infected lining and also securer purchase for the serum agar. The prepared tube is filled with antiseptic. And then we can, after an interval, pour out the antiseptic, fill in with nutrient broth or trypsinised serum, and then incubate. Any microbes which have been left alive in the lining will now grow out into colonies which can be inspected through the walls of the tube.

Let me show you a set of typical results obtained by the test-procedures just described, using Dakin's antiseptic, to-day perhaps the most popular of all antiseptics.

In tube 1 we have obtained, as you can see by these subcultures, complete sterilisation. And it was obtained after only momentary contact with the antiseptic. In tube 2, where a lightly infected serum was shaken up with an equal bulk of the antiseptic and then incubated, we have in our mixture of serum and antiseptic a very vigorous growth of microbes. You see the medium has become turbid, and there has been an evolution of gas which has pushed up the plug of congealed vaseline. In tube 3—and here the antiseptic stood for four hours in the tube—we have in the barrel a teeming multitude of microbes. And in tube 4, after four hours' contact with the antiseptic, only that very thin layer of the infected lining which coats the barrel has been sterilised, in the depth of every spike the bacterial colonies have come up quite thickly, and only in immediate contact with the antiseptic have the microbes been killed. And I here show you in a companion tube which has been incubated twenty-four hours longer that the microbes you have seen growing in the deeper layers very soon penetrate the sterilised superficial layer, and grow out in the culture medium in the barrel of the tube.

When we find an antiseptic giving results quite different from those here displayed it will then, for the first time, become a rational policy to use, and leave behind, an antiseptic in a wound with the view of safeguarding the patient during lengthy transport.

Suggestion that the bacterial infection in the wound can be kept down during transport by frequent re-applications of an antiseptic.—In the earlier period of the war the only method of re-applying an antiseptic was that of taking down the dressing, syringing the wound, and completely re-dressing. That was, especially in the case of deep wounds and compound fractures, a very lengthy and painful procedure, and one which was nearly impracticable in transport. For that complete re-dressing there has now been substituted by Carrel a procedure for washing and refreshing the surface of the wound through rubber tubes. According to Carrel, Dakin's antiseptic should be employed, and this should be applied every two hours. About the application of this in transport let me say this: that it would, I think, be impracticable to carry it out on a sufficiently large scale and sufficiently systematically; and Dakin's antiseptic applied in an unsystematic manner gives exactly the same results as simply keeping the wound wet.

Suggestion that the set-back in the wound during transport could be prevented by dressing with hypertonic salt solution.—The set-back in the wound with its resulting tragedies could, I think, be avoided by drawing out lymph in a continuous manner from the tissues, and holding up the emigration of leucocytes. The outflow of lymph would drive back and expel invading microbes. It would also prevent the conditions in the walls of the wound becoming unwholesome to leucocytes. The continuous outpouring of lymph would also effectively combat the corruption of the discharges in the cavity of the wound. And, lastly, it would prevent any drying up of the wound. The effect of holding up the emigration of leucocytes would be to prevent the corruption of the wound discharges. You will remember that leucocytes, breaking down, furnish the trypsin which corrupts the discharges.

We have in a hypertonic solution the therapeutic agent we require for these purposes. The proper way of using it is to apply to the wound three or four layers of lint thoroughly soaked in 5 per cent. salt solution; to impose upon these, as a reinforcement, three or four more layers of lint thoroughly soaked in saturated salt solution,[3] and then cover the whole with jaconet, or other impermeable material.

REMEDIAL TREATMENT.

I now pass from discussion of the method of preventing the set-back that occurs in transport to the discussion of its remedial treatment. The set-back will, as we have seen, have given us either a tryptic suppurating wound or a dry slough-covered wound. In each case the *first item in treatment* will be to get a clean surface. For that it will, in the case of the tryptic suppurating wound, suffice to wash away the tryptic pus. In the case of the desiccated slough-covered wound we must get rid of the sloughs. The rational way to do that will be by *cleansing digestion.* Such cleansing digestion can be obtained by treating the wound with hypertonic salt solution. This will, as we have already seen, break down leucocytes, setting free trypsin, and then the free trypsin will rapidly, and especially rapidly if we let the hypertonic salt undergo dilution, amputate the dead from the living tissues. Let us note that what we set out to do by the use of hypertonic salt solution is only to achieve more rapidly, and, as we shall see, with less risk of infection, what putrefaction and the destruction of leucocytes by microbes would, if we allowed things to run their course, spontaneously effect. The *second item* of treatment in each case will be to combat the infection which has found a lodgment in the walls of the wound cavity. To deal with this we require an outpouring lymph stream, obtained by hypertonic salt solution.

If the train of reasoning I have laid before you is correct, it will follow that hypertonic salt solution is the agent we require both for preventing the set-back due to interruption of treatment in transport, and also for remedial treatment.

EXPERIMENTS WHICH EXHIBIT THE PROPERTIES OF HYPERTONIC SALT SOLUTION.

You will very reasonably here expect me to produce experiments to show that a hypertonic salt solution has the virtues I ascribe to it. You will want to see for yourselves that it attracts water, draws out fluid from moist tissues, sets free trypsin from pus, and initiates digestion. There is room here[4] only for the two following experiments, which have reference to the digestive cleansing of the wound.

Experiment 1.—I have here, as you see, two test-tubes filled nearly to the top with egg-albumen. To this was added $\frac{1}{2}$ per cent. of carbolic acid, and the albumen was then solidified by immersing the tubes in boiling water. That done, I took two cotton-wool plugs and steeped them in a pus to which I had added $\frac{1}{2}$ per cent. of carbolic acid. I then inverted my tubes, the one into a beaker containing 5 per cent. salt, the other into a beaker containing physiological salt solution. (Fig. 11, A and B.) To these also I added $\frac{1}{2}$ per cent. of carbolic acid. You will understand why I chose carbolic acid as my antiseptic when I tell you that it is one which does not destroy trypsin or impede digestion. You see in the drawings made

[3] The saturated solution diluted with six parts of water will give us o[r] 5 per cent. salt.

[4] The experiments on the drawing action of strong salt solution were s[et] out in the fuller report of the lecture published in the *Lancet* of June 23.

after the tube had been incubated for forty-eight hours, that in tube A, the tube which was immersed in hypertonic salt solution, the egg-albumen was extensively digested, while in tube B there was only a mere trace of digestion.

Experiment 2.—I here try to imitate the conditions of slough-covered wounds. I have in these beakers a

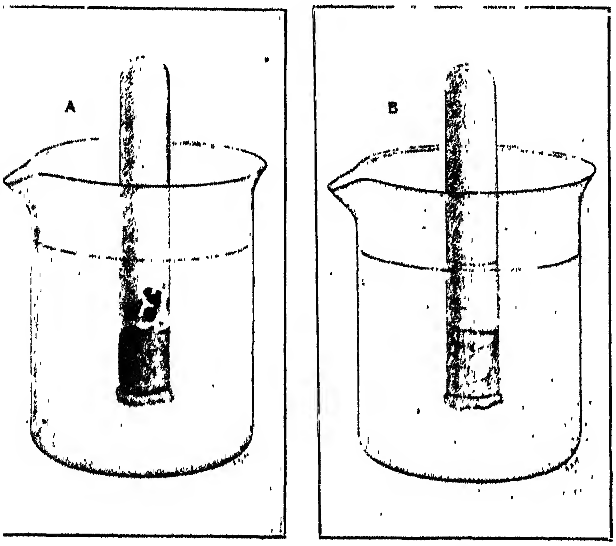


FIG. 11. Test-tubes filled with coagulated egg-albumen; then plugged with cotton-wool impregnated with pus; and then inverted into beakers. Beaker A contains hypertonic, beaker B normal salt solution.

foundation of coagulated white of egg containing 0·5 per cent. of carbolic acid. On the top of this I have in each case a disc of lint, woolly side up, firmly fastened down by adding another layer of egg-albumen and coagulating this by heat. Upon the lint I have poured a non-tryptic pus, giving, of course, an equal amount to each beaker. In this way I have made what I think can pass as a fairly close representation

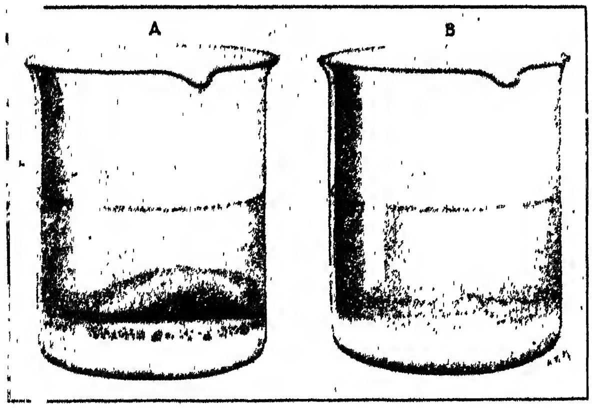


FIG. 12. Beakers containing coagulated egg-albumen into which is embedded a layer of lint. Upon the lint was poured pus, and upon this in the case of beaker A hypertonic, and in the case of beaker B normal salt solution. In beaker A the artificial slough has separated off by tryptic digestion.

of a pus-impregnated slough firmly adherent to the floor of a wound. (Fig. 12, A and B.)

We now pour upon one of the artificial sloughs 5 per cent.; upon another 0·85 per cent. solution made with ½ per cent. of carbolic acid; and we may pour on a third Dakin's solution. We now place them in the incubator. You see here what has happened after twenty-four hours. In beaker A, where the artificial slough has been treated with hypertonic salt solution, the slough has loosened itself from its bed, and floats up as I pour in water. In beaker B, where I imposed only physiological salt solution, the slough is still firmly adherent. And the same holds of beaker C (not figured), where we have Dakin's solution.

TREATMENT OF THE WOUND IN THE CASE WHERE WE HAVE ONLY A SURFACE INFECTION.

When we have got back to a clean and only lightly infected surface we must think out our next step. It will help if we first review what we have learned and get things into proper perspective.

We have learned that there are in wound infections two supreme dangers. *First,* there is the danger associated with the buried infection. We have appreciated that the effective and only remedy for this is the immediate opening up of the infected dead spaces. That, you will remember, is a question of converting a buried infection into a surface infection. The *second* very serious danger is that intensification of the surface infection which follows upon a lengthy interruption of treatment during transport. This, regarded from the point of view of loss of life and limb, ranks next in order of importance after delay in dealing with the buried infection. When the set-back due to transport has been prevented or remedied, we have confronting us the problem which, if treatment had been uninterrupted, would have presented itself earlier—the problem as to how to treat a slight infection of a naked-tissue surface.

One procedure is to leave the wound to heal up from the bottom, limiting oneself to such re-dressing as would prevent erosive digestion. By this programme the patient would, when his wound is a large one, be condemned to very many months of disability and also of bacterial intoxication. For the fact has got to be faced that it is all but impossible to maintain satisfactory conditions in a large wound for months on end.

The alternative programme is for the surgeon to close the wound with the minimum delay. If the anatomical conditions permit, and the bacteriological examination shows the wound surface to be practically uninfected, or if the wound is only a very few hours old and the implanted microbes cannot yet have grown out, the wound can, after removal of all dead and foreign matter, be immediately closed—the surgeon, of course, standing by to reopen the wound if symptoms of buried infection develop. If, on the other hand, bacteriological examination shows that the wound surface is appreciably infected, or the history of the case makes this practically certain, we should, by closing the wound, be violating all the principles of surgery. We should be converting a surface infection into a buried infection. The proper step to take with a wound which is appreciably infected is to reduce the microbic infection to the point at which it is negligible and then re-suture.

Methods of Dealing with a Microbic Infection which Stands in the Way of Secondary Suture.

The microbic infection may be dealt with by any one of the following procedures.

In the *first place* we can employ the physiological procedure. If we elect to do this, we must think out clearly the requirements. For example, it will be inappropriate when dealing with a purely superficial streptococcic and staphylococcic infection to continue the application of hypertonic salt solution. The effect of that would be, on one hand, to hold off phagocytes from the microbes (for strong salt arrests

emigration); and, on the other, to provide the staphylococcus and streptococcus with lymph, a fluid in which they can grow and disseminate themselves over the whole face of the wound. What we want is an application which calls out leucocytes, which will restrain, or at any rate will not activate, the lymph flow. Physiological salt solution, and zinc sulphate in $\frac{1}{4}$ per cent. solution, and no doubt many other heavy metal salts in dilute solution, are the sort of agents we require. But what is, above all, essential to success in physiological treatment of a surface infection is assiduity in removing any leucocytes which may break down upon the face of the wound. That is a question of maintaining intact the antitryptic power of the lymph on the wound surface.

A *second method* of procedure—I may call it the *unreasoning antiseptic procedure*—is to employ an antiseptic, without laying stress upon the assiduous cleansing of the wound surface and the maintenance of good physiological conditions; without inquiring whether the antiseptic can, when brought into external contact with pus or an infected tissue, penetrate into it; and without asking whether the antiseptic hinders phagocytosis, or destroys the antitryptic power of the blood fluids, or permits or interferes with tryptic action.

This unreasoning antiseptic procedure is constantly employed. It has led to failure upon failure, and it would be a matter for wonder if it did succeed.

The *third* and last method of procedure I may call the *combined antiseptic and physiological procedure.* If we want to find a method of this sort we shall not find it by inquiring for it under this name. What we have to seek is a method which proclaims itself an antiseptic method and in this guise combats effectively, but perhaps not with full comprehension, corruptive changes in the wound.

The method of Carrel is, as I think, such a method. I would propose to show that it is a combined antiseptic and physiological method; then to survey the results obtained; and, finally, to consider how far the results should be credited to the antiseptic, and how far to the physiological, element in the treatment.

We have in Carrel's treatment two factors: (*a*) Dakin's antiseptic, or, as I should prefer to call it, Dakin's therapeutic agent; and (*b*) Carrel's procedure for washing and refreshing the wound surface in the intervals between the complete dressings. Now each of these factors acts not only by killing or removing microbes, but also by making the conditions in the wound unfavourable for microbial growth. Let me, taking first Dakin's fluid and then Carrel's washing procedure, try to make for you an inventory of their directly anti-bacterial, and their physiological or indirectly anti-bacterial, effects.

Dakin's Fluid.

Dakin's fluid is, as I have shown you,[5] a very ineffective antiseptic when it is brought into application upon microbes suspended in serum. It is also, as I have likewise shown you, an antiseptic which has as good as no power of penetrating into albuminous fluids. It is also an extremely volatile antiseptic. When exposed in a shallow dish at blood temperature I have found it to lose four-fifths of its potency in half an hour, and it will, as I have already had occasion to point out, if not already quenched by contact with serum, very quickly disappear from the wound.

Turning from the effect exerted upon microbes to the effect exerted upon the wound surface, let me recall to those of you who have seen it that when a naked-tissue surface is treated with Dakin's fluid (or, for the matter of that, with 5 per cent. salt solution) it is speedily converted into a bright coral-red granulating surface. That means it is converted into a defensive surface excellently well provided with new-formed blood-vessels from which active leucocytes and fully potent lymph will emerge. That is a physiological action to the good. But there are also other effects exerted. Leucocytes are affected by Dakin's fluid. Experiments show that it is destructive to phagocytosis. When we add one part of the reagent to nine of *excoagular blood* we reduce the phagocytic power of that blood by more than one-half. We abolish phagocytosis when we add one part of the reagent to four of blood. The fluid elements of the discharge also are altered in character by Dakin's fluid. Let me remind you here that we saw in our experiments on artificial sloughs that treatment with Dakin's solution hinders the digestive processes which bring about their separation. This stands in relation to the fact that the reagent exerts upon trypsin, when albumen is not there to act as a buffer, a destructive action. We have, as you perceive, here a physiological action which may quite well come into operation when a comparatively clean but tryptic wound surface is flushed. Dakin's fluid abolishes also the antitryptic power of the blood fluids. It would seem, therefore, with one hand to give protection, and with the other to take it away. But what really does happen is, I suppose, that trypsin and antitrypsin alike are destroyed by the flush and that afterwards in the wound a new beginning is made.

Let us follow up the train of thought here started. We may, I think, profitably ask ourselves whether, if put to our election between maintaining antiseptic action continuously at the expense of physiological action, and alternating antiseptic with physiological action, we should not do well to elect for the latter policy. And we may muse whether it was not specially felicitous to have employed, as Carrel has done, an antiseptic which is very readily quenched and also very volatile and to have applied it discontinuously. Had that antiseptic been employed by a method of continuous irrigation, phagocytosis on the face of the wound would have been excluded, and we might have had in the cavity of the wound a lymph the antitryptic power of which had been destroyed.

But I have already said enough about Dakin's fluid if you have appreciated that it is a poor antiseptic; that it acts as a poison upon leucocytes and blood fluids; that its physiological action is a very complicated one; and that its beneficial effects cannot be due simply to its antiseptic action.

Carrel's Method of Irrigating the Wound.

I now come to Carrel's procedure of intercalating between the complete dressings a frequent flushing and refreshing of the wound surface and for carrying out this flushing unlaboriously. Allow me to say that we have here, I think, far the most important contribution made to surgical technique since the beginning of the war. But to that let me add that, while Carrel's procedure gives us a new and improved technique for the application of antiseptics, much more does it give us a new and improved technique for physiological treatment. In all physiological treatment the assiduous removal of corrupted and corruptible discharges is the primary desideratum.

We now turn to the results of the treatment of infected wound surfaces by Carrel's method, and we may take them from Carrel's book. But it will b[e] well, in order to keep to the kind of wound infectio[n] here under discussion, to exclude from consideratio[n] wounds complicated with fractures—for in those effec[-]tive washing is difficult. And we may further, look[-]ing to the classification of wounds of soft parts i[n]

[5] *Vide supra*, Experiments on Antiseptics.

Carrel's book, exclude from consideration his class of phlegmonous and gangrenous wounds and his class of suppurating wounds. These would correspond to wounds which have, through postponement of treatment or its interruption by transport, suffered a setback, converting an originally light surface infection into a heavy infection with invasion of the deeper tissues. There would then fall within our purview only his class of fresh wounds of soft parts taken in hand when five to twenty-four hours old. And we learn from the data he gives with respect to these that, where there are sloughs, fifteen to twenty days, and, where there are none, five to twelve days, are required to prepare the wound for secondary suture. That gives us a measure of what can be done by what I have, I hope not unjustifiably, called Carrel's "combined antiseptic and physiological treatment."

Let us consider what Carrel's results tell us. They tell us in the first place that, whatever else it is, Carrel's treatment is not in any sense a *therapia magna sterilisans*. Regarded as an antiseptic method, it is a method of "*fractional sterilisation*" requiring for the case we are considering—the simplest case of all—at the rate of twelve douches a day a series of 60 to 144 antiseptic douches. And if I am right in regarding Carrel's treatment as a combined antiseptic and physiological treatment, we have, superadded to the antiseptic, a series of 60 to 144 physiological attacks upon the microbes each such attack starting from an atryptic condition.

The consideration of these figures leads directly to what I have to say in conclusion. While Carrel's work constitutes a very notable practical achievement, regarded as science it comes short in the respect that adequate control experiments are lacking. I do not mean that it has not been demonstrated that Carrel's treatment accomplishes what was impossible by the old system of syringing with antiseptics and leaving the wound afterwards to fill with pus. The inefficacy of that older treatment was attested by tens and hundreds of thousands of control experiments. What I mean is that we have not in Carrel's work any control experiments with more potent and penetrating antiseptics to negative the idea that with these one could with fewer than 60 to 144 consecutive douches convert a light surface infection into a negligible one. And again, we have not from Carrel any control experiments with a well-thought-out physiological treatment to negative the idea that one could achieve a similar sterilisation by 60 to 144 successive physiological attacks upon the microbes, starting each time from an atryptic condition.

If we would abide in the spirit of science, every unwarranted assumption must go. We must not assume that when we have successfully combated a surface infection by a series of 60 to 144 therapeutic operations we have reached finality. And much less must we, from the fact that a treatment successfully combats surface infections, infer that it is also an effective treatment for infections which penetrate into the deeper tissues. It ought to come home to us instead that it is impossible that for quite different categories of wounds, *i.e.* for quite diverse conditions, there should be any one routine treatment.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A pamphlet has been received from University College, London, giving full particulars of the University centre for preliminary and intermediate medical studies arranged in connection with the faculty of medical sciences of the college. The college faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Each of the departments is also equipped for more advanced work and provides facilities for research. Numerous scholarships and exhibitions are available for intending medical students, detailed regulations concerning which can be obtained on application to the secretary, Dr. W. W. Seton, at the college.

The calendar for the session 1917–18 of the Royal College of Science for Ireland has now been published. The college provides a complete course of instruction in those branches of science which are connected with agriculture, engineering, and manufactures, and it trains teachers of science for technical and secondary schools. By the prosecution of researches in pure and applied science the college has been able to render aid to the agricultural and industrial development of Ireland. The regular courses of study extend over four years, and lead to the associateship of the college. The fellowship of the college may be awarded to any associate of at least three years' standing who submits a thesis, which shall meet with the approval of the dean and council, embodying the results of his own original scientific research, or who has submitted satisfactory evidence that he has contributed in a marked degree to the advancement of science. A limited number of research studentships may be awarded each session to qualified persons who desire to prosecute approved lines of research. The college is administered by the Department of Agriculture and Technical Instruction for Ireland.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, August 13.—M. Paul Appell in the chair.—G. **Humbert**: The reduction (mod 2) of quadratic binary forms.—C. **Richet** and H. **Cardot**: A new method of determining the reducing substances in urine. The diluted urine is allowed to act upon an acidified solution of potassium permanganate under conditions such that the urea is not oxidised. A manganese coefficient for normal urine is established, and this is shown to be independent of the total urea excreted.—E. **Cahen**: The series of best absolute approximation for a number.—L. **Picart**: The total eclipse of the moon of July 4, 1917. Observations made at the Bordeaux-Floirac Observatory showed that during the whole period of total eclipse the north edge of the moon was more luminous than the south edge; the western edge was more luminous up to the middle of the eclipse.—G. **Sizes**: The German gamma termed "harmonic," or "exact," or improperly modern, from the point of view of musical acoustics.—P. **Portier**: The physiological *rôle* of symbiotic micro-organisms.—MM. **Abelous** and **Aloy**: The biochemical phenomena of oxido-reduction. Repeating the experiments of Bach on the ferment in milk, it was found that a large number of substances besides aldehydes may act as co-ferments, such as amines, terpenes, and manganese salts. Details are given of the simultaneous reduction of sodium chlorate and oxidation of salicylic aldehyde.—Mme. C. **Cardot** and H. **Cardot**: The analogy between the lactic ferments and streptococci from the point of view of the action of disinfectants. The growths of the lactic bacillus and streptococcus under the action of increasing amounts of two antiseptics, sodium fluoride and phenol, were compared. The curves expressing the results of the experiments show close agreement, and the authors conclude that laws

established for a non-pathogenic bacillus, such as the lactic ferment, may be applied to pathogenic organisms.

August 20.—M. J. Boussinesq in the chair.—Y. **Delage**: First results of the study of deep currents by means of the bathyrheometer.—J. **Deprat**: The inflexions of the tectonic directions in the north of Annam and their relations.—Mlle. M. **Bensaude**: Sexuality in the Basidiomycetes.—A. **Lécaillon**: Biology of the caterpillars and moths of *Bombyx mori* having a parthenogenetic origin.

PETROGRAD.

Academy of Sciences (Physico-mathematical Section), April 12.—E. S. **Fedorov**: Application of the principles of the new geometry to crystallo-optics.—V. Ja. **Roškovskij**: Contributions to the study of the family Lymnæidæ.—V. V. **Zalenskij**: The development of the embryo of *Salpa bicaudata*.—V. K. **Soldatov**: Description of a new species of Krusensterniella, Schmidt.—A. **Šestakov**: The new species of the genus Cerceris, Latr., in the Zoological Museum of the Academy of Sciences.—V. L. **Bianchi**: (1) Notes on the Russian Chiroptera. (2) Notes on the avifauna of North Tobolsk. (3) The birds of Francis Joseph Land collected by Lieut. Sedov's expedition.—A. F. **Samojlov**: Positive oscillation of the current of repose of the auricle of the turtle during excitement of the pneumogastric nerve.—I. S. **Plotnikov**: The softening and bending of carbon at high temperatures.—N. S. **Kurnakov**, K. F. **Běloglazov**, and M. K. **Šmatko**: Deposits of potassium chloride in the Solikamsk salt formation.

April 27.—M. D. **Zalěsskij**: *Noeggerothiopsis aequalis*, Goepp. sp., on the foliage of *Mesopitys Tchihatcheffi* (Goepp.), Zalěsskij.—A. S. **Vasiljev**: Correction of the length of the Moloskovitzi and Pulkovo bases measured in 1888.—V. S. **Žardeckij**: Researches on the spectrum of the variable η Aquilæ.—A. S. **Vasiljev**: The monthly period in the variations of latitude.—M. M. **Kamenskij**: Researches on the motion of Wolf's comet.—N. N. **Donič**: Observations of the solar eclipse of April 16–17, 1912.—V. Č. **Dorogostajskij**: The birds of the Government of Irkutsk.—V. F. **Ošanin**: (1) The genera of the family Strachiaria, Put. (Heteroptera, Pentatomidæ). (2) Two new species of Pentatomidæ from southern Persia.—S. F. **Žemčužnij** and V. K. **Petraševič**: Electric conductivity and hardness of manganese-copper alloys.—A. A. **Borisiak**: Description of the skeleton of a small rhinoceros, *Epiaceretherium turgaicum*.—O. A. **Walther**: The dialysis of diastases.—V. N. **Ipatjev** and A. **Andriuščenko**: The absorption of carbonic acid by saline solutions under high pressure.

Historico-philological Section, April 19.—K. A. **Inostrancev**: The Iran-Vedža river in Parsee tradition.

BOOKS RECEIVED.

Report of the Royal Ontario Nickel Commission, with Appendix. Pp. xlviii+219+62. (Toronto: A. T. Wilgress.)

La Force et le Droit, le Prétendu Droit Biologique. By Prof. R. Anthony. Pp. 194. (Paris: F. Alcan.) 2.50 francs.

Food Poisoning. By E. O. Jordan. Pp. viii+115. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1 dollar, or 4s. net.

Finite Collineation Groups, with an Introduction to the Theory of Groups of Operators and Substitution Groups. By Prof. H. F. Blichfeldt. Pp. xi+193. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.50 dollars, or 6s. net.

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year ending June 30, 1916. Pp. 236. (Washington: Government Printing Office.)

Smithsonian Contributions to Knowledge. Vol xxxv., No. 3. A Contribution to the Comparative Histology of the Femur. By Prof. J. S. Foote. Pp. ix+242+plates 35. (Washington: Smithsonian Institution.)

A Course in Mathematical Analysis. Differential Equations, being part ii. of vol. ii. By Prof. E. Goursat. Translated by Prof. E. R. Hedrick and O. Dunkel. Pp. viii+300. (Chicago and London: Ginn and Co.) 11s. 6d. net.

The Munition Workers' Handbook. A Guide for Persons taking up Munition Work. With special chapters on Shell Turning and Gear Cutting. By E. Pull. Second edition. Pp. 158. (London: Crosby Lockwood and Son.) 2s. 6d. net.

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